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2018 Grassroots Prospecting Report for the Mount Jamie North Gold Project, Red Lake, Ontario, Canada

Report Prepared For



BOUNTY
GOLD CORP.

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1.0 Introduction

1.1 Property Description

The Mount Jamie North Claim Group consists of thirty-two (32) unpatented mining claims situated in Todd Township, Red Lake Mining Division, District of Kenora (Patricia portion), Northwestern Ontario. The Red Lake area is located 250 km NE of Winnipeg, Manitoba, 150 km NNW of Dryden, Ontario and 430 km NW of Thunder Bay, Ontario.

1.2 Claims

The Mount Jamie North Claim Group consists of thirty-two (32) contiguous unpatented mining claims covering 448 hectares. The claims consist of fifteen (15) Boundary Cell Mining Claims and seventeen (17) Single Cell Mining Claims. A list of claims, tenure status, anniversary date and tenure ownership by Bounty Gold Corp is provided in Appendix A.

The property is centered on UTM co-ordinates (NAD83, Zone 15), 419128 m E, 5659465 m N. The claims are registered with the Ontario Ministry of Northern Development and Mines, Provincial Recording Office.

No exploration plan or permit is currently active for the property. Exploration Permit # PR-14-10522 was issued August 4, 2014 but expired August 3, 2017. None of the activities undertaken during the present program required an exploration plan or permit to be in place.

1.3 Location and Access

The property is located within Todd Township approximately 24 km northwest of the Red Lake townsite. Access to the claims is via Highway 125 to Nungesser Road. 16 km north of the junction of Highway 125 and Nungesser Road, turn west onto Pine Ridge Forest Access Road. Continue west for 22 km on Pine Ridge Forest Access Road, then turn south onto the Mount Jamie Mine access road. Continue to the historic Mount Jamie Mine site, located approximately 28 km down the Mount Jamie Mine access road. The eastern boundary of the property is then accessed by travelling an additional 1.1 km down the Scott Bay Landing access trail.

The property, situated on Red Lake, can also be accessed by float plane and boat from the Red Lake townsite. By boat, the property is ~37 km west of the Red Lake townsite (Howey Bay).



1.4 Climate, Local Resources and Infrastructure

The Red Lake area is located in an area characterized by northern continental climate, with warm summers and cold winters. Lake freeze-up typically occurs in mid-November, and break-up is typically in early-May. Snow cover is typical from late-October through early-May. Geological mapping and sampling is easiest outside of these winter seasons. Winters are generally harsh, with nightly low temperatures below -30°C common in January and February. Although winter conditions are not conducive to geological mapping, sampling and stripping overburden (due to ground frost penetration), drilling in the area is commonly performed from the surface of frozen lakes, permitting access to areas that are inaccessible or less accessible to drills during the summer months.

The Municipality of Red Lake (pop. 5,000) is a full-service community with extensive social (schools, hospital), recreational (golf course, recreation centers) and infrastructure (power, paved roads, gravel roads, water, sewer) in place. A well-trained labour force and numerous mining supply companies are established in the community to service the gold mines that are active or under construction in the community (Goldcorp, Rubicon).

Supplies and services which cannot be found in Red Lake can be delivered via Highway 105 (paved) from the Trans-Canada Highway (165 km south of Red Lake), or flown into the Red Lake Airport (with 5,000 ft asphalt runway and new terminal building constructed in 2011).

Water is available on the property from Red Lake (no permitting to take large volumes of water is currently in place). Grid power is not available on the property. Minor power requirements can be satisfied with the use of portable generators.

1.5 Physiography

The property is underlain by rock of the Canadian Shield, with low rolling hills. Red Lake is approximately 356 m above sea level, with the surrounding hills rising to 390 m, a variance of approximately 34 m. Overburden is generally shallow (with localized exceptions), and outcrops are common in areas of higher relief. A small portion of the claim group, at its western extremity, is covered by the waters of Red Lake. No other lakes or ponds of significance occur on the claim group.



2.0 Geological Setting

2.1 Regional Geology

The following description of the Geology of the Red Lake greenstone belt was modified from Sanborn-Barrie et al. (2004) and the references therein.

The Mount Jamie North Gold Project is located in the Uchi Subprovince of the Superior Province of the Canadian Precambrian Shield. Within the Uchi Subprovince, the Red Lake greenstone belt is host to one of Canada's preeminent gold producing districts with over 20 million ounces of gold produced since the 1930s.

The belt is interpreted to have evolved on the south side of the North Caribou terrain, an ancient continental block originating approximately 3 billion years before present (Ga) (Figure 8). The terrain evolved from extensive magmatic and sedimentary activity which occurred from 3.0 to 2.7 Ga with multiple events of intense deformation, metamorphism, hydrothermal alteration and gold mineralization. Regional metamorphic assemblages range from greenschist to amphibolite facies.

The tholeiitic and komatiitic metabasalts of the **Balmer Assemblage**, dated approximately between 3,000 and 2,988 million years before present (Ma), are the oldest volcanic rocks in the greenstone belt and host the major lode gold deposits in the Red Lake district. The assemblage consists of lower, middle and upper massive to pillowed tholeiitic metabasalt sequences separated by distinctive felsic and ultramafic metavolcanic rocks. Metasedimentary rocks also occur within the assemblage, mainly as thinly bedded magnetite-chert ironstone.

Underlying the northwestern portion of the Red Lake greenstone belt is the **Ball Assemblage** (approximately 2,940 to 2,925 Ma) consisting of a thick sequence of metamorphosed intermediate to felsic calc-alkaline flows and pyroclastic rocks.

The **Slate Bay Assemblage** (approximately 2,903 to 2,850 Ma) extends the length of the belt and consists of clastic rocks of three main lithological facies varying from conglomerates, quartzose arenites, wackes and mudstones. The contact of the Slate Bay assemblage with the Ball and Balmer assemblages represents an unconformity (Figure 9).

A thin sequence of calc-alkaline dacitic to rhyodacitic pyroclastic rocks of the **Bruce Channel Assemblage** (approximately 2,894 Ma) were deposited and overlain with clastic sediments and a chert-magnetite iron formation. Enriched LREE trace element profiles relative to the Balmer assemblage are interpreted to indicate crustal growth at a juvenile continental margin.

The **Trout Bay Assemblage** (approximately 2,853 Ma) is exposed in the southwest portion of the Red Lake greenstone belt. It is a volcano-sedimentary sequence consisting of a lower tholeiitic basalt unit overlain by clastic rocks and interbedded with an intermediate tuff and a chert-magnetite-iron formation.



Following a lull in volcanic activity for approximately 100 million years, the **Confederation Assemblage** represents a time of widespread calc-alkaline volcanism (approximately 2,748 to 2,739 Ma). The approximately 2,744 Ma quartz-feldspar-porphyrific lapilli tuff of the Confederation assemblage forms the hanging wall at Madsen Mine.

Overlying the McNeely sequence in the Confederation assemblage is the Heyson sequence of tholeiitic basalts and felsic volcanics. Isotopic and geochemical data suggests the McNeely rocks were formed during a shallow marine to subaerial arc on the existing continental margin with later intra-arc extension and eruption forming the Heyson sequence. In the Madsen area, the strata of the Confederation and Balmer assemblages depict an angular unconformity with opposing facing directions. The Balmer assemblage was, thus, overturned prior to the deposition of the Confederation assemblage.

Following the Confederation assemblage, the **Huston Assemblage** (approximately between 2,742 and 2,733 Ma) records a time of clastic sedimentary deposition varying from immature conglomerates and wackes. The Huston assemblage has been compared to the Timiskaming conglomerates commonly associated with gold mineralization in the Timmins camp of the Abitibi greenstone belt (Dubé et al., 2003). The Huston was followed by the **Graves Assemblage** (approximately 2,733 Ma) of calc-alkaline volcanism dominated by andesitic to dacitic pyroclastic tuff, and synvolcanic diorite and tonalite.

Plutonic rocks found in the Red Lake greenstone belt correlate with various stages of volcanism. These include mafic to ultramafic intrusions during Balmer and Ball time periods, gabbroic sills related to Trout Bay volcanism, felsic dikes and diorite intrusions during the Confederation assemblage, and intermediate to felsic plutons, batholiths and stocks of Graves assemblage age.

Post-volcanism plutonic activity is also evident from granitoid rocks such as the **McKenzie Island Stock**, **Dome Stock** and **Abino Granodiorite** (2,720 and 2,718 Ma) which were host to past producing gold mines. The last magmatic event recorded in the belt is from about 2.7 Ga with a series of potassium-feldspar megacrystic granodiorite batholiths, plutons and dikes, including the **Killala- Baird Batholith**.

Structurally, the belt displays evidence of several deformational events with associated hydrothermal activity and gold mineralization. The main episode of penetrative deformation occurred after Confederation volcanism 2.74 Ga. This D_1 deformation event resulted in the formation of northerly trending south-plunging F_1 folds and associated fabrics. The likely cause of deformation is a change in plate dynamics such as the shallowing of a subducted slab creating compression in the upper plate and the displacement of magmatic activity.

A second important deformational event superimposes D_1 structures. East to northeast trending D_2 structures occur in western and central Red Lake, and southeast trending folds and fabric are present in eastern Red Lake such as at the Campbell and Red Lake mines. The onset of penetrative D_2 strain across the belt from 2.72 Ga is interpreted to document the collision of the North Caribou Terrain and the Winnipeg River Subprovince to the south.



2.2 Geology of Todd Township and Project Area

From the perspective of gold prospectivity, the most prominent feature within Todd Township is a large regional fold structure, with the fold hinge located around 422805 E, 5657654 N. From the fold hinge, the fold limbs extend SW (235°) and NW (290°). Confederation Minerals' Newman-Todd Project is located between 1,700 and 3,900 meters SW of the hinge. West Red Lake Gold Mines' Rowan Project overlays the fold hinge itself, the initial 1,700 meters of the SW limb to the boundary of Confederation Minerals' Newman-Todd Project, as well as the initial 3,000 meters of the NW limb to Bounty Gold Corp's Mount Jamie North Project. Bounty Gold Corp's Mount Jamie North Project is located between 3,000 and 5,700 meters NW of the hinge.

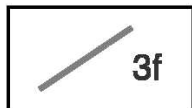
Sedimentary lithological units of chert-magnetite, chert-marble and banded iron formations, occasionally stromatolitic and brecciated, define the SW and NW limbs. Descriptions from *Sanborn-Barrie et. al. (2004)* are provided below:



Chert-magnetite; chert-magnetite-sulphides, typically overlying and transitional with stromatolitic chert-marble unit.



Chert-marble: locally stromatolitic including coarse-grained wollastonite- and/or diopside-bearing metamorphosed equivalents along northern margin of belt, north of Pipestone Bay; displays pseudofossil mound 'Atikokania' on west shore Golden Arm.



Chert-magnetite ironstone.

Drilling by Confederation Minerals along their portion of this horizon (SW limb) has outlined an 1,800 meter gold-bearing structure called the Newman-Todd Structure (NTS). West Red Lake Gold Mines has outlined a further 1,700 meter structure (NT Breccia Zone) along the SW limb to the Hinge Zone. Along the initial 1,500 meters of the NW limb, West Red Lake Gold Mines has identified another gold-bearing structure referred to as the Main Breccia Zone. The "Hinge Zone" on West Red Lake Gold's Rowan Mine Property is mapped (Sanborn-Barrie et. al 2004) as being near the intersection of major F1 syncline and F2 anticline structures. It is worth noting that within the established "mine trend" in the eastern portion of the Red Lake Greenstone Belt, many of the large gold deposits are associated with such structures and structural intersections. These deposits include Rubicon's F2 (Phoenix) Project, Goldcorp's Bruce Channel Deposit and Goldcorp's Campbell Mine-Dickenson Mine (Red Lake Gold Mines), which have produced in excess of 20M ounces of Au. These deposits are located across ~15 linear kilometers of the eastern "mine trend".



Enclosed by the NW and SW limbs of the regional fold structure, and generally forming the footwall to the sedimentary horizons referenced above, lies felsic-intermediate-mafic volcanics associated with the Ball Assemblage. Further west, at the center of the Ball Assemblage lies a large mafic-ultramafic (serpentinite, peridotite) unit, mapped by Sanborn-Barrie as intrusive in nature. The former felsic-intermediate sequence also shows gold-bearing potential associated with gold-bearing quartz veins emplaced parallel to sub-parallel and proximal to the F2 axial fold anticline. These gold-bearing quartz veins were the primary focus of early exploration in Todd Township, and the historic minor producers (Rowan Mine, Mount Jamie Shaft # 1 and Mount Jamie Shaft # 2) are located 300 to 3,000 meters on strike to the SE of the Mount Jamie North Gold Project.

3a

Lower basalt: massive to locally pillowed, calc-alkaline basalt with low TiO_2 (<0.7%), modest LREE-enrichment and primitive mantle (PRIM) normalized Th/Nb >2.

3c

Intermediate calc-alkaline volcanic rocks: dacitic to lesser andesitic rocks dominated by pyroclastic tuff and lapilli tuff, locally spherulitic in Pipestone and Sadler bays ±siltstone; characterized by pronounced LREE-enrichment and high PRIM-normalized Th/Nb; may include altered pillowed basalt north of Rowan Lake.

3d

Felsic calc-alkaline volcanic rocks; thin rhyodacitic and rhyolitic flows and tuff including 2940.1 ±2.4/-1.7 Ma massive rhyolite flows (U-Pb #5), typically quartz phyrlic and sericite-bearing, locally plagioclase phyrlic; with pronounced LREE-enrichment (type F1) and high PRIM-normalized Th/Nb.

To the east of the NW and SW limbs of the regional fold structure, and generally forming the hanging wall to the sedimentary horizons referenced previously, lies predominantly mafic flows (basalt) of the Balmer Assemblage and sediments (sandstone, wacke, conglomerate) associated with the Slate Bay Assemblage. To that end, the NW and SW limbs of the regional fold structure may also define boundaries between major assemblages, although the precise nature and exact location of the boundaries are still poorly understood.

1m

Upper tholeiitic basalt flows and associated gabbroic rocks: pillowed and massive flows, aphyric, characterized by TiO_2 <1.3% and LREE depletion; extensively altered; carbonate-cemented breccia along north shore of central Red Lake may reflect close proximity to unconformity between Meso- and Neoproterozoic volcanic assemblages.



Quartz arenite±siltstone±feldspathic wacke±conglomerate: quartz arenite is locally graded with crossbedding, fuchsite-bearing; conglomerate contains grit-size angular lasts of fine-grained felsic volcanics, free quartz and fuchsite.

Andrews, et. al. (1986) suggested the presence of key structural “deformation zones” within the Red Lake Greenstone Belt. One such deformation zone, the Pipestone Bay-St.Paul Bay Deformation Zone is mapped from the historic Buffalo Red Lake Mines, proceeding 23 km at 290° to the NW before trending through the center of the Mount Jamie North Gold Project, after which it continues to the western extremity of the Red Lake Greenstone Belt. This interpreted deformation corridor and associated hydrothermally altered rocks overprints the previously referenced NW limb of the regional fold structure, as well as the parallel to sub-parallel quartz veins associated with the F2 fold axis.

3.0 Project Exploration

3.1 Historic Exploration on the Property

Historic claim maps and geological maps show the area presently consisting of Bounty Gold Corp’s Mount Jamie North Project as part of Hall et. al (Horwood, 1940) and WS Hall (R.A. Riley, 1971) patents. A list of the historic patents and their rough corresponding equivalents to Bounty Gold Corp’s unpatented mining claims (prior to conversion) are provided below:

Historic Patent or Mining Lease	Current Unpatented Mining Claim	Notes
KRL10418	4267832	Only the portion not under the water of Red Lake
KRL10419	4267832	
KRL10424	4267832	
KRL12504	4267832	Only the portion not under the water of Red Lake
KRL11639	4267833	
KRL11638	4267833	
KRL11595	4267833	
KRL11730	4267833	
KRL11596	4267834	
KRL11597	4249788	
KRL13415	4249788	

No records could be located with respect to early exploration efforts, although R.A. Riley’s 1971 map (M2406) of the Geology of Todd Township shows historic trenches on the peninsula covered by unpatented mining claim 4267833, and some of these trenches, now infilled with soil, moss and other vegetation, were located during Bounty’s recent exploration programs.



By 1984, it appears the patents were held by Biron Bay Resources Limited. In that year, Biron Bay Resources Ltd. completed geophysical magnetic and EM horizontal loop surveys. The magnetic survey over the present claim group were interpreted to conform with geological mapping (Riley, 1971?) of Todd Township, with large portions “underlain by volcanic rocks and volcanosediments, with iron formations showing 4000 to 7000 gamma peaks”. The EM horizontal loop surveys highlight three conductors on the present claim group, named Conductors F, G and H. Summaries of each conductor are provided below:

Conductor	Strength	Width	Magnetic Correlation	Magnetic Peak	Details
F	Strong	20-70 m	Direct	7825	Conductivity appears to be strong with direct magnetic correlation. Related to chemical sediments and iron formations possibly the combination of magnetite and pyrrhotite.
G	Strong	10 m	Direct	5702	High and moderate conductivity correlates with moderately high magnetic peak. This conductor appears to be located on the contact of mafic and intermediate volcanics and requires further investigation.
H	Weak	1-100 m	Very Broad	2535	Under water it appears to be weakly conductive, associated with a low broad magnetic feature.

The report recommended that further work be done on Conductors F and G consisting of prospecting, mapping and sampling, although no record of subsequent work could be located. The Biron Bay Resources Limited report of 1984 was the only record of direct work that could be located with respect to the present claim group.

By the early 2000’s, Biron Bay Resources land holdings (including the patents that covered the present claim group) were part of Redstar Gold Corporation’s West Red Lake Properties land package. Although the historic patents are referenced within several Redstar assessment work reports, no direct evidence of work on the present claim group was found. There is occasional reference regarding the need to conduct greenfield exploration on the eastern portion of their holdings, which is assumed to be a reference to the area of interest.



3.2 Exploration on Adjacent Properties

The adjacent Mount Jamie Mine Property and Rowan Mine Property (further east), now held by West Red Lake Gold Mines Inc. have been the subject of extensive historic and recent exploration work. A plethora of assessment work reports and technical data can be found with respect to these properties, not all of which has been reviewed by Bounty Gold Corp. to date. The closest historic mine workings, the Mount Jamie # 2 shaft, which was sunk to a depth of 559 feet in 1941, is only 300 meters south of claim 4267834 and 400 meters east of the present boundary of claim 4267832. The “North Vein” on which this shaft was sunk strikes NW toward the present claim group.

A Hy Lake Gold Inc. (now West Red Lake Gold Mines Inc.) news release dated May 30, 2012 highlights recent exploration successes. The map accompanying the news release identifies three corridors with strong gold mineralization and one weaker corridor, all of which have been traced west-northwest to within a few hundred meters of and trend toward Bounty Gold Corp’s present claim group. These were named the “West Mt Jamie Trend”, “North Vein Trend”, “Golden Tree Trend” and “North Golden Tree Trend”.

A more thorough review of all the historic reports and technical data with respect to the adjacent Mount Jamie and Rowan Mines is needed, but initially the possibility that the main mineralized corridors could trend on to Bounty Gold Corp’s claim group appears very promising.

In 1988 Biron Bay Resources collared a single diamond drill hole (BB-87-10) on KRL12504. The hole was 1,120 feet in length. The exact collar location has not yet been located, but appears to be within the current claim group, possibly within the vicinity of 418104 E, 5658895 N. However, the majority of the hole (azimuth not provided) appears on maps to be directed slightly east of north, and therefore is primarily within the adjacent KRL12504 covered by the waters of Red Lake and not within Bounty Gold Corp’s current claim group. This hole appears to have intersected 2000 ppb (Au?) or 0.058 oz/t over 1.0 ft between 78.0 and 79.0 ft downhole. The location of this intercept may be very close to and possibly related to anomalous gold values found during the present prospecting program and discussed further below (see discussion with respect to samples MJJ-021-15 through MJJ-023-15).

3.3 Recent Exploration by Bounty Gold Corp

Two distinct areas of highly anomalous gold mineralization (between 500 and 1000 ppb Au) were located during the initial prospecting programs in 2014-15.

The first area centered around coordinates 418133 E, 5658885 N. At this location, three samples were collected of dark grey to greenish mafic volcanics along the shoreline of Scott Bay. This location is estimated to be southeast and in the same general area of the drill intercept previously referenced in drill hole BB-87-10. The three samples were each collected several meters apart across the interpreted width of the mafic unit. The contacts of the mafic unit with adjacent rocks were not observed. The sample collected furthest north (MJJ-022-15) at the waterline returned 440 ppb Au. This sample was



very well foliated with talc along the foliation planes. It was fine-grained and weakly silicified. Sample MJJ-021-15 was collected 1 meter east and 2 meters south. It included a small, discontinuous quartz vein 1-2" wide. Although neither the quartz nor surrounding host rock was mineralized, this sample returned 875 ppb Au. Another 1 meter east and 2 meters further south, another sample (MJJ-023-15) was collected. This sample had more distinct, alternating grey-greenish layers. Again, although no obvious mineralization was noted, this sample returned 795 ppb Au. The fact that each sample, collected across several meters of the interpreted width of the mafic unit, contained anomalous values highlights the need for further prospecting, sampling and mapping in this area.

The second area centered around coordinates 418028 E, 5659266 N. At this location, a well mineralized, smokey grey quartz vein hosted within felsic to intermediate volcanics was found. The vein, in the small area it is exposed, was measured to be 15-20 cm wide. To the SE, the vein runs into the water of Scott Bay, to the NW it runs under overburden, therefore the potential length could not be determined, nor could it be sampled along strike. The felsic to intermediate volcanics hosting the vein were also found to be well mineralized in the immediate wall rock to the quartz vein. Three samples of the quartz vein and two samples of the mineralized wall rock were collected. Samples MJJ-024-15, MJJ-025-15 and MJJ-026-15 of the quartz material returned 510 ppb Au, 845 ppb Au and 790 ppb Au, respectively. Samples MJJ-027-15 and MJJ-028-15 of the host rock material assayed 485 ppb Au and 365 ppb Au, respectively. Smaller, less mineralized quartz veins occur further east (within 10 meters) along the shoreline, within the felsic-intermediate host unit. Three other samples collected along this shoreline to the east of the quartz vein returned values between 45 – 110 ppb. To the immediate west of the quartz vein along the shoreline a pinkish felsic unit was noted. Although the quartz vein material was not of particularly high grade, the presence of an Au-mineralized quartz vein approximately on strike to the NW of the historic Mount Jamie Mine workings is encouraging. Perhaps follow up prospecting in this area could reveal the quartz vein further along strike, or the presence of parallel or en-echelon veins of higher grade.

Aside from these two areas of particularly anomalous gold mineralization, the following observations were made elsewhere during the 2014-2015 prospecting program:

1. Samples MJJ-001-14 through MJJ-006-14 and MJCL-001-14 through MJCL-003-14 were collected in the southern portion of claim 4267832. Regional geologic maps indicated this area may be underlain by rocks of ultramafic affinity. ICP analysis of these samples do, in fact, indicate much higher Cr and Ni than generally found elsewhere, although Mg reaching a peak of 7.96% in sample MJJ-005-14 was somewhat lower than expected for ultramafics. MJJ-003-14 through MJJ-005-14 had more intense carbonate alteration. Specifically, a specimen kept of MJJ-004-14 appears to show two distinct generations of carbonate alteration, one overprinting/cross-cutting sub-parallel to the other. A specimen kept of MJJ-005-14 has the weathered appearance of ankerite. Two samples from this general area assayed higher than 100 ppb Au, with MJJ-003-14 returning 110 ppb and MJCL-001-14 returning 175 ppb Au. West Red Lake Gold Mines' "West Mt Jamie Trend" strikes toward this general area of Bounty Gold Corp's claim group. Samples MJJ-012-15 through MJJ-019-15 were also collected in the southern portion of claim 4267832, but further west along the shoreline of Red Lake. These



samples also exhibit similar characteristics to the aforementioned samples, being of more ultramafic affinity and having more intense carbonate alteration than the general population of samples from the claim group.

2. Iron formation or Fe-rich metasedimentary units were encountered at 418755 E, 5659200 N and again at 417788 E, 5659542 N. Only one sample (MJJ-003-15) was collected at the former location, while 10 samples (MJCL-001-15 through MJCL-010-15) were collected in the general area around the latter. At the latter site, although still low (>150 ppb Au), gold values were generally found to be elevated above background, and accompanied by modestly higher Ag, As and Sb (all good pathfinder elements associated with gold mineralization).
3. Samples MJCL-011-15 through MJCL-020-15 were generally collected ~100 m south of the latter iron formation referenced above. These samples again exhibited characteristics of ultramafic affinity (elevated Cr, Ni, Mg). These roughly correspond to a unit mapped as “serpentine, serpentinized pyroxenite and peridotite” on R.A. Riley’s Todd Township geological map (1971).
4. Samples MJJ-007-14 through MJJ-010-14 were collected from the area surrounding historic trenches (418626 E, 5659283 N) on R.A. Riley’s Todd Township geological map (1971). Although some of the old trenches were located and overburden is relatively shallow, the trenches are infilled with soil and vegetation. Samples MJJ-009-14 and MJJ-010-14 were float samples collected from one of these trenches while trying to locate bedrock. Although gold values from these two samples were low, the samples were rusty staining, well mineralized, and possibly a quartz breccia with intermediate volcanic host rock. The observed characteristics of the samples, and the fact that the area seemed to receive more attention and efforts from early prospectors are suggestive that additional follow up work in this area is required. Details regarding the nature of the samples will only be possible by examining them within the broader context of exposed outcrop.

Prospecting conducted in 2016 identified one new area with sub-economic gold mineralization. This area occurs at 417756E, 5659529N on the northwest tip of the peninsula on which historic trenches are found. The gold mineralization occurs in and immediately surrounding a banded iron formation. Samples MJCL-005-16 through MJCL-010-16 were collected here, and all six samples were found to have gold values elevated above background, with sample MJCL-008-16 being the highest at 1105 ppb Au.

A significant portion of the samples collected in 2016 were taken in the area of 418660E, 5659275N where historic trenches are found. Although the trenches are infilled with moss and soil (and one was full of water), bedrock was easily re-exposed for sampling along the length of the longest trench.

Despite a broad zone of mineralization, no significant gold values were obtained from the samples collected from this trench. The only values obtained above 10 ppb Au were taken from a smaller trench further west at 418622E, 5659279N. Although the three samples collected at this location were only found to have gold up to 30 ppb, the ICP shows elevated Bi (0.98-2.63 ppm), Te (0.51-1.4 ppm)



and Ag (0.62-0.93 ppm). These pathfinder elements would be expected to occur as enrichments within the mineralized quartz vein systems of the historic Mt. Jamie and Rowan mines further to the southeast. This was a difficult location to sample, since water in the bottom of the historic trench quickly filled the excavation that exposed bedrock shortly after the samples were collected, thus not allowing very detailed observation of the host rock. There may be a mineralized quartz breccia here, but this could not be conclusively determined for these reasons.

3.4 Present Exploration Program

The present prospecting program consisted of outcrop sampling and assaying. The prospecting was conducted by two prospectors over 8 field person-days, including mobilization, sample collection, sample processing, demobilization and 3 person-days for report/map writing. A total of 51 outcrop rock samples were collected and submitted for Au, 52-element ICP (four acid digestion) and whole-rock analysis. A table summarizing the samples, sample location, Au assays and brief sample description is provided below, followed by a brief discussion of relevant observations.

All 51 outcrop samples were collected on cell # 315944.



Sample ID	Easting	Northing	Au (ppb)	Sample Description
MJDL-001-18	417786	5659467	29	Grab sample. Finely laminated, fine grained ultramafic. Banded. Silicified. Calcite bands? No obvious sulphides. Micaceous. Rusty-weathering. Non-magnetic.
MJDL-002-18	417786	5659467	9	Grab sample. Collected ~40 cm above (vertically) previous sample. Same description, well-foliated ultramafic. No sulphides.
MJDL-003-18	417786	5659467	98	Grab sample. Collected ~40 cm NW of MJDL-001-18. Ultramafic. Well foliated. Minor sulphides. Silicified.
MJDL-004-18	417786	5659467	19	Grab sample. Collected ~100 cm vertically above MSDL-005-18. Ultramafic. Well foliated. Siliceous. Calcite. Micaceous. Some sulphides (perhaps to 1%) noted in this sample. Py.
MJDL-005-18	417785	5659468	31	Grab sample. Collected ~60 cm W-NW of MJDL-003-18. Same description as previous. Well foliated ultramafic. Minor sulphides.
MJDL-006-18	417786	5659467	273	Grab sample. Collected ~20 cm W-NW of MJDL-004-18. Similar description but pieces of this sample have strong rusty weathering, rare fresh surfaces show magnetite and sulphide rich sections. Magnetic (strongly) locally. Pyrite is coarse.
MJDL-007-18	417785	5659467	7	Grab sample. MJDL-007-18 through MJDL-009-18 are three samples collected ~80 cm vertically above MJDL-010-18. Collected across crevasse in the outcrop (shear maybe?). Similar descriptions to previous.
MJDL-008-18	417785	5659467	212	Grab sample. MJDL-007-18 through MJDL-009-18 are three samples collected ~80 cm vertically above MJDL-010-18. Collected across crevasse in the outcrop (shear maybe?). Similar descriptions to previous. MJDL-008-18 includes more rusty, magnetic gossaneous sections like MJDL-006-18.
MJDL-009-18	417785	5659467	88	Grab sample. MJDL-007-18 through MJDL-009-18 are three samples collected ~80 cm vertically above MJDL-010-18. Collected across crevasse in the outcrop (shear maybe?). Similar descriptions to previous. MJDL-009-18 less foliated, more calcite-rich with sulphides to 1% associated with the calcite. Also locally magnetic
MJDL-010-18	417785	5659468	374	Grab sample. Collected ~60 cm W-NW of MJDL-005-18. Very rusty weathering, gossaneous. No fresh surfaces to observe composition. Magnetic. Also vertically below the previous three samples.
MJDL-011-18	417784	5659469	59	Grab sample. Collected ~120 cm above (vertically) MJDL-012-18. Well laminated. Ultramafic. One sulphide-rich section (coarse Py) appears to cross cut foliation. Overall sulphides less than 1%. Silicified. Calcite.
MJDL-012-18	417784	5659469	23	Grab sample. Collected ~60 cm W-NW of MJDL-013-18. Very well foliated. Micaceous. Ultramafic. No obvious sulphides. Rusty weathering. Magnetic.



Sample ID	Easting	Northing	Au (ppb)	Sample Description
MJDL-013-18	417784	5659468	43	Grab sample. Collected ~50 cm W-NW of MJDL-010-18. Similar description to previous sample. Well foliated. Rusty. Micaceous. Ultramafic. This sample is non-magnetic to weakly magnetic though.
MJDL-014-18	417784	5659468	158	Grab sample. Collected ~80 cm W-NW of MJDL-012-18. There is a change in composition here, with MJDL-014-18 and MJDL-015-18. These two samples are possibly banded iron formation??? Strongly magnetic. Not strongly foliated like the samples further east are. Minor sulphides. Siliceous/cherty bands are orange.
MJDL-015-18	417784	5659468	43	Grab sample. Collected ~80 cm W-NW of MJDL-012-18. There is a change in composition here, with MJDL-014-18 and MJDL-015-18. These two samples are possibly banded iron formation??? Strongly magnetic. Not strongly foliated like the samples further east are. Minor sulphides. Siliceous/cherty bands are orange.
MJDL-016-18	417784	5659468	45	Grab sample. Collected beside MJDL-014-18 and MJDL-015-18. Although still strongly magnetic, looks different than previous samples. Ultramafic with dirty greenish-grey quartz-carb. More abundant sulphides (1-3%).
MJDL-017-18	417784	5659468	127	Grab sample. Collected beside MJDL-014-18 and MJDL-015-18. Although still strongly magnetic, looks different than previous samples. Ultramafic with dirty greenish-grey quartz-carb. MJDL-017-18 shares features of MJDL-014-18/MJDL-015-18 as well as MJDL-016-18. Also 1-3% sulphides.
MJDL-018-18	417783	5659468	406	Grab sample. More closely resembles MJDL-016-18. Ultramafic with greenish-grey quartz-carb veining. Abundant sulphides (3-5%) as cubic Py and some disseminated Py in milky white quartz-carb areas.
MJDL-019-18	417783	5659468	33	Grab sample. Same general location as MJDL-014-18 to MJDL-018-18. Same description as previous. Also some hematite and strong weathering (rusty). Magnetic. Sulphides 1-3%.
MJDL-020-18	417783	5659469	28	Grab sample. Collected ~100-120 cm W-NW of previous samples. Most closely resembles samples MJDL-016-18 and MJDL-018-18 with greenish quartz-carb. Sulphides 1-3%.
MJDL-021-18	417783	5659470	14	Grab sample. Collected ~80-100 cm W-NW of MJDL-020-18. Similar composition, but may include more calcite. Sulphides not as strong, maybe to 1%.
MJDL-022-18	417782	5659470	20	Grab sample. Collected ~50 cm W-NW of MJDL-021-18. Similar composition, silicified ultramafics. Less abundant quartz veining and not as heavily mineralized. Sulphides less than 1%.



Sample ID	Easting	Northing	Au (ppb)	Sample Description
MJDL-023-18	417787	5659466	68	Grab sample. Collected ~ 3 m SE of MJDL-001-18. Well foliated ultramafic. Non-magnetic. Trace sulphides.
MJDL-024-18	417789	5659464	100	Grab sample. Collected ~6 m ESE of MJDL-023-18. Finely banded, very well foliated ultramafic. Rusty weathering. Weakly magnetic. Minor sulphides (less than 1%).
MJDL-025-18	417792	5659461	<5	Grab sample. Collected ~3 m ESE of MJDL-024-18. Finely banded, very well foliated felsic (dacite) to intermediate (andesite). More siliceous than previous samples, it appears. Trace sulphides. Non-magnetic.
MJDL-026-18	417791	5659462	<5	Grab sample. Collected ~2 m WNW of MJDL-027-18. Well foliated felsic to intermediate, same as previous sample. No obvious sulphides.
MJDL-027-18	417795	5659459	<5	Grab sample. Collected ~4 m ESE of MJDL-025-18. Same composition as previous but includes a narrow 0.5" unmineralized quartz vein. Overall sulphides less than 1%. Some pyrite as plating on fracture surfaces.
MJDL-028-18	417796	5659458	<5	Grab sample. Collected ~1.5 m ESE of MJDL-027-18. Intermediate, not as finely banded as previous samples. Minor pyrite less than 1%.
MJDL-029-18	417801	5659455	<5	Grab sample. Collected ~7 m ESE of MJDL-027-18. Intermediate, foliated but not banded. No obvious sulphides.
MJDL-030-18	417801	5659454	34	Grab sample. Collected ~3 m ESE of MJDL-029-18. Intermediate. This sample is more chloritic (greenish) and includes some quartz veining which carries minor sulphides.
MJDL-031-18	417783	5659468	340	Grab sample. Collected another sample of MJDL-018-18. Same location and description as that sample.
MJDL-001-18	417781	5659467	59	Grab sample. Collected a few meters vertically above MJDL-020-18. Similar composition, ultramafic with greenish (chloritic?) quartz. Magnetic. Minor sulphides, less than 1%.
MJDL-002-18	417780	5659467	7	Grab sample. Collected ~2 m W of MJDL-001-18. Fine grained ultramafic. Not really banded. Rusty, but non-magnetic. Sulphides to 1%. Foliated.
MJDL-003-18	417779	5659467	7	Grab sample. Collected ~50 cm WNW of MJDL-002-18. Fine grained ultramafic. Banded. Well foliated. Rusty. Non-magnetic. Sulphides to 1%.
MJDL-004-18	417779	5659467	33	Grab sample. Adjoins to the west of MJDL-003-18. Same description. Fine grained, well laminated ultramafic. Sulphides to 1%.
MJDL-005-18	417779	5659467	40	Grab sample. Adjoins to the west of MJDL-004-18. Same description. Fewer sulphides.



Sample ID	Easting	Northing	Au (ppb)	Sample Description
MJL-006-18	417779	5659467	24	Grab sample. Adjoins to the west of MJL-005-18. Same description. Also no obvious sulphides.
MJL-007-18	417779	5659468	42	Grab sample. Collected ~75 cm WNW of MJL-006-18. More closely resembles MJL-001-18. Also magnetic. Some sulphides, less than 1%. Ultramafic. Some orange-brownish looking quartz.
MJL-008-18	417779	5659468	20	Grab sample. Collected ~40 cm NW of MJL-007-18. This sample mostly fine grained lighter coloured material. Well foliated. No obvious sulphides.
MJL-009-18	417778	5659468	9	Grab sample. Collected ~30 cm WNW of MJL-008-18. Well foliated ultramafic. Non-magnetic. No obvious sulphides.
MJL-010-18	417778	5659468	6	Grab sample. Collected ~70 cm WNW of MJL-009-18. Ultramafic. Not as well foliated. More similar to MJL-007-18 but non-magnetic. Trace sulphides.
MJL-011-18	417778	5659470	12	Grab sample. Collected ~250 cm NW of MJL-010-18. Ultramafic. Trace sulphides. Weakly magnetic.
MJL-012-18	417777	5659471	81	Grab sample. Collected ~30 cm NW of MJL-011-18. Rusty weathering, well foliated. Lighter colour. Trace sulphides. Fine grained.
MJL-013-18	417777	5659471	14	Grab sample. Collected ~30 cm NW of MJL-012-18. Composition is similar to MJL-011-18. Also magnetic. No obvious sulphides.
MJL-014-18	417776	5659471	75	Grab sample. Collected ~120 cm NW of MJL-011-18. Very rusty weathering, almost gossaneous. Similar composition to previous but more quartz. Few fresh surfaces. Sulphides maybe 1-3%.
MJL-015-18	417776	5659471	62	Grab sample. Collected ~30 cm WNW of MJL-014-18. Similar composition but not as rusty/gossaneous. Ultramafic. Minor sulphides.
MJL-016-18	417775	5659472	57	Grab sample. Collected ~130 cm W of MJL-014-18. Same description as previous.
MJL-017-18	417775	5659472	43	Grab sample. Collected ~30 cm W of MJL-016-18. This sample resembles MJL-014-18, very rusty/gossaneous, more quartz and sulphides to 1-3%. Strongly magnetic.
MJL-018-18	417775	5659472	44	Grab sample. Collected ~30 cm W of MJL-017-18. Also very rusty. The few fresh surfaces look more felsic than previous samples. Fewer sulphides, only trace.
MJL-019-18	417774	5659472	15	Grab sample. Collected ~110 cm W of MJL-016-18. Silicified ultramafic. Rusty weathering. Magnetic. Quartz. Sulphides to 1%.
MJL-020-18	417773	5659472	12	Grab sample. Collected ~150 cm W of MJL-019-18. Same description. Silicified ultramafic. Rusty. Quartz. Magnetic. Sulphides to 1%.



Discussion of 2018 Prospecting Program

2018 sampling was concentrated on an ultramafic unit identified at 417783 E, 5659468 N. The ultramafic unit was found to be sheared, altered and mineralized. The highest gold assay obtained was from sample MJDL-018-18, at 406 ppb Au. This sample was heavily mineralized with coarse and disseminated sulphides.

Of interest, nearly all of the ultramafic samples collected during the present prospecting program also had anomalous Ag, well above background levels. Of the 51 samples collected, 45 were of ultramafic affinity and carried average Ag of 1.36 ppm. By comparison, the 6 felsic-intermediate samples averaged 0.09 ppm Ag. 25 of the ultramafic samples had greater than 1.0 ppm Ag, with a maximum value of 4.9 g/t in sample MJDL-010-18. This sample also had the highest As (8 ppm) and Sb (1.2 ppm) of the 51 samples collected in 2018. Ag, As, and Sb are all good pathfinder elements.

While sub-economic, 2018 sampling demonstrates yet another type of potential host rock to gold mineralization on the property, which is promising. Sampling in previous years has identified gold mineralization up to ~1.0 g/t Au in iron formation (MJCL-008-16 – 1105 ppb Au), smokey quartz veins (MJJ-025-15 – 845 ppb Au) and a sericite altered mafic unit (MJJ-021-15 – 875 ppb Au).

4.0 Recommendations

Preliminary prospecting on the Mount Jamie North Gold Project has now identified four areas of low-grade gold mineralization, and several additional areas demonstrating good alteration, mineralization or other characteristics often associated with hydrothermal flows and gold emplacement. Additionally, exploration activities on adjacent, and other properties along the same geological trend continue to expand the known mineralized zones as well as the geological understanding of the regional-scale structure which is presumed to transect the property. The potential of the property to host economic-grade gold mineralization is considered to be good.

Near-term early exploration activities should continue to focus on property-wide prospecting (sampling, mapping), and research of exploration work on adjacent properties, and how the data and observations may be useful in focusing exploration activities on the Mount Jamie North Gold Project. The four areas identified as having low-grade gold mineralization should receive additional follow-up sampling and prospecting along strike.

Jason D. LeBlanc, President/CEO
Bounty Gold Corp.



5.0 References

Andrews, A.J., Hugon, H., Durocher, M., Corfu, F., and Lavigne, M., 1986: The anatomy of a gold-bearing greenstone belt: Red Lake, northwestern Ontario; Gold '86 Symposium, Toronto, September 1986, p. 3–22.

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Vamos, P.J.: Diamond Drilling Assessment Work Report for Biron Bay Resources Limited, 52M01SE0016, 1988.

Vamos, P.J.: Report on Geophysical Surveys – Ball and Todd Townships for Biron Bay Resources Limited, 52M01SE0002, 1984.



Appendix A – Claims

Township / Area	Tenure ID	Tenure Type	Anniversary Date	Tenure Status	Tenure %	Work Required
TODD	101935	Single Cell Mining Claim	2019-01-14	Active	100	\$400
TODD	101936	Single Cell Mining Claim	2018-12-15	Active	100	\$400
TODD	113434	Boundary Cell Mining Claim	2019-01-14	Active	100	\$200
BALL,TODD	130612	Boundary Cell Mining Claim	2018-12-15	Active	100	\$200
TODD	136495	Boundary Cell Mining Claim	2018-12-15	Active	100	\$200
TODD	141970	Boundary Cell Mining Claim	2018-12-15	Active	100	\$200
TODD	141971	Boundary Cell Mining Claim	2018-12-15	Active	100	\$200
TODD	143174	Single Cell Mining Claim	2019-01-14	Active	100	\$400
TODD	156737	Single Cell Mining Claim	2019-01-14	Active	100	\$400
TODD	171885	Boundary Cell Mining Claim	2019-01-14	Active	100	\$200
TODD	203511	Single Cell Mining Claim	2018-12-15	Active	100	\$400
TODD	209380	Single Cell Mining Claim	2019-01-14	Active	100	\$400
TODD	209381	Single Cell Mining Claim	2019-01-14	Active	100	\$400
TODD	213356	Single Cell Mining Claim	2018-12-15	Active	100	\$400
TODD	220754	Boundary Cell Mining Claim	2018-12-15	Active	100	\$200
TODD	223632	Single Cell Mining Claim	2019-01-14	Active	100	\$400
TODD	230901	Boundary Cell Mining Claim	2019-01-14	Active	100	\$200
TODD	230902	Boundary Cell Mining Claim	2018-12-15	Active	100	\$200
BALL,TODD	232057	Boundary Cell Mining Claim	2018-12-15	Active	100	\$200
TODD	237788	Single Cell Mining Claim	2018-12-15	Active	100	\$200
TODD	255833	Boundary Cell Mining Claim	2018-12-15	Active	100	\$200
TODD	256516	Boundary Cell Mining Claim	2019-01-14	Active	100	\$200
TODD	257400	Single Cell Mining Claim	2019-01-14	Active	100	\$400
TODD	257401	Boundary Cell Mining Claim	2019-01-14	Active	100	\$200
TODD	259577	Single Cell Mining Claim	2018-12-15	Active	100	\$400
BALL,TODD	268784	Boundary Cell Mining Claim	2018-12-15	Active	100	\$200
TODD	278125	Single Cell Mining Claim	2018-12-15	Active	100	\$200
TODD	296940	Single Cell Mining Claim	2018-12-15	Active	100	\$400
TODD	311285	Boundary Cell Mining Claim	2018-12-15	Active	100	\$200
TODD	315944	Single Cell Mining Claim	2018-12-15	Active	100	\$400
TODD	328702	Single Cell Mining Claim	2018-12-15	Active	100	\$400
TODD	328703	Single Cell Mining Claim	2018-12-15	Active	100	\$400
						\$9,400



Appendix B – Summary of Exploration Activities

Date	Activity
October 6, 2018	Mobilization, Jason LeBlanc and Dennis LeBlanc haul boat using ¾ ton truck (x 2) from Medicine Stone Resort to Red Lake townsite (~40 km).
October 7, 2018	Jason LeBlanc and Dennis LeBlanc accessed property by boat from Red Lake. Collected 51 samples MJDL-001-18 through MJDL-031-18 (Dennis) and MJJL-001-18 through MJJL-020-18 (Jason)
October 20, 2018	Jason LeBlanc, MJDL-001-18 through MJDL-031-18 sample processing (examination under rock microscope, descriptions) and preparation for assay submission.
October 21, 2018	Jason LeBlanc, MJJL-001-18 through MJJL-020-18 sample processing (examination under rock microscope, descriptions) and preparation for assay submission.
November 8, 2018	Demobilization, Jason LeBlanc and Dennis LeBlanc haul boat using ¾ ton truck (x 2) from Red Lake townsite back to Medicine Stone Resort (~40 km).
December 7, 8 and 9	Jason LeBlanc, prospecting report and maps.
TOTAL	8 field person-days , 3 person-days report/map writing



Appendix C – Summary of Exploration Expenditures

	# of Units	Unit	Cost/Unit	TOTAL
Sample Assays	51	samples	\$136.79	\$6,976.11
Jason - Labour	5	days	\$300.00	\$1,500.00
Dennis - Labour	3	days	\$300.00	\$900.00
Boat Rental	2	days	\$75.00	\$150.00
ATV Rental	0	days	\$75.00	\$-
Truck Mileage	160	km	\$0.50	\$80.00
Meals	2	field days	\$75.00	\$150.00
Work Report	24	hours	\$37.50	\$900.00
				\$10,656.11

Breakdown of Rock Sample Au, Whole Rock and ICP Assay Expenses (Included in Table Above)

	MJ Samples	Cost per Sample	% MJ	TOTAL
Au	51	\$56.50	100.0%	\$2,881.50
XRF	51	\$34.95	100.0%	\$1,782.45
ICP	51	\$29.60	100.0%	\$1,509.60
			HST	\$802.56
			TOTAL	\$6,976.11



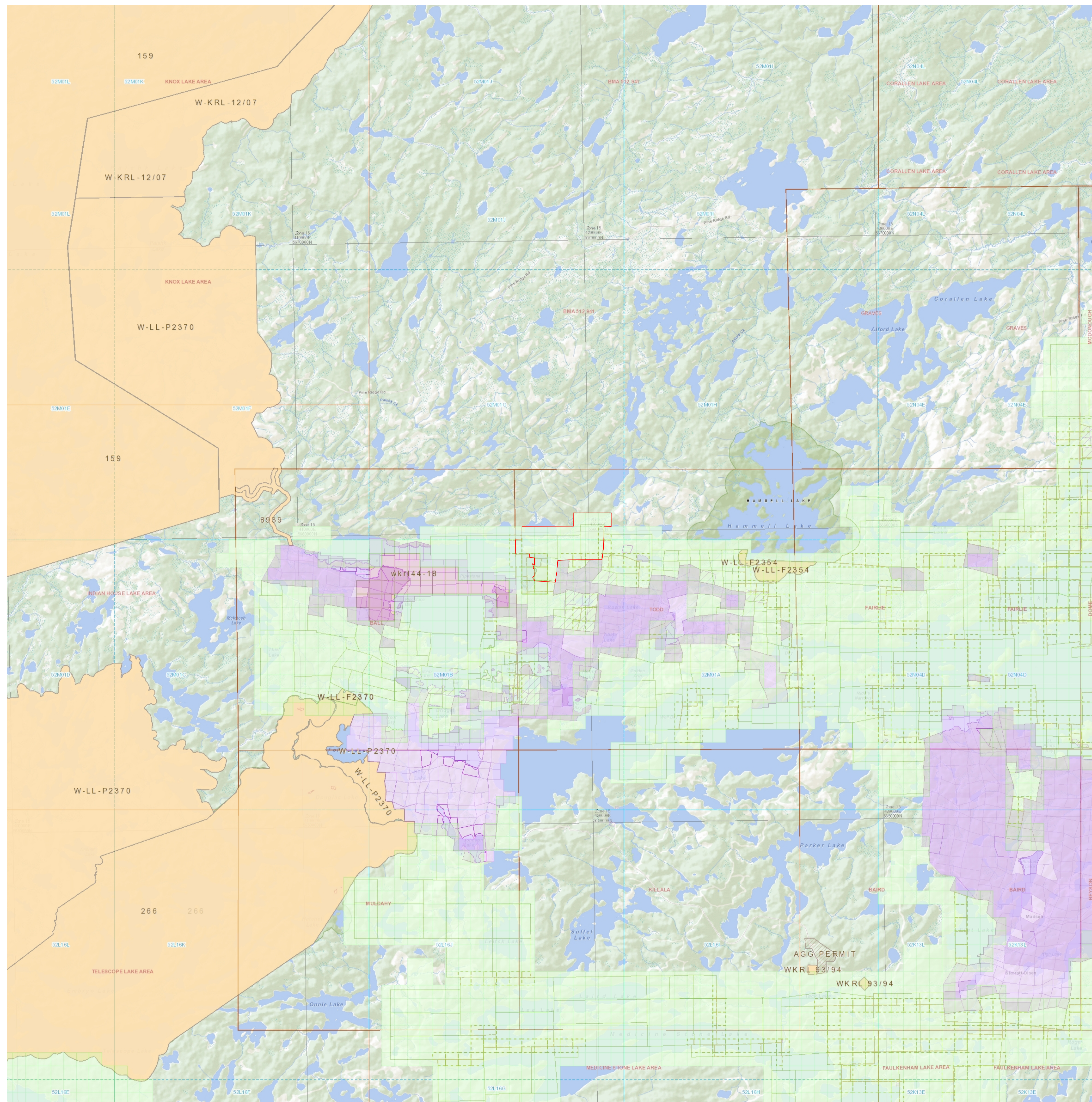
Appendix D – Maps



Ontario Ministry of Northern Development and Mines
Mining Lands Claim Map

Administrative Districts

Township
TODD
Mining Division
Red Lake
Land Registry
KENORA
MNR District Office
Red Lake

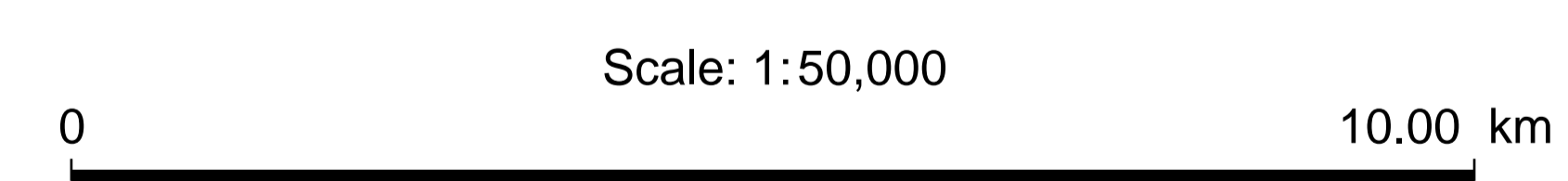


Topographic

- Building as Symbol
- Building to Scale
- Runway
- Report 1 Hospital Helipad
- Seaplane Base
- Ferry Route
- Trail Head 1
- Trail
- Railway 1 Train Station
- Railway with Bridge
- Railway with Tunnel
- Road (Major -> Minor)
- Winter Road
- Road with Bridge
- Road with Tunnel
- Primary, Kings of 400 Series Highway
- Secondary Highway
- Intercity Highway
- District, County, Regional or Municipal Road
- Toll Highway
- One Way Road
- Road with Permanent Social Passage
- Road with Address Ranges
- Hydro Line, Communication Line or Unknown Transmission Line
- Natural Gas Pipeline, Water Pipeline or Unknown Pipeline
- Spot Height
- Index Contour
- Contour
- Wooded Area
- Wetland
- Waterbody
- Watercourse Elevation
- Watercourse
- Falls
- Rapids
- Rapids - Falls
- Rock
- Lock Gate
- Dam - Hydro Wall
- Dam - Hydro Wall
- Provincial / State Boundary
- International Boundary
- Upper Tier / District
- Municipal Boundary
- Lower Tier / Single Tier
- Municipal Boundary
- Lot Line
- Indian Reserve
- Provincial Park
- National Park
- Conservation Reserve
- Military Lands

Legend

- Administration Boundaries
 - Mining Divisions
 - Resident Geoped District
 - Townships and Areas
 - UTM Grid
 - Geographic Left Fabric
 - Other Federal Land
- Mineral Tenure Grid
 - Ontario Tenure Grid
- Alienations
 - Notice
- Unpatented Claim
 - Active
 - Rescinded
 - Forfeited
- Disposition
 - Disposition
- Disposition Symbols
 - Camp
 - Disposition Unresolved
 - Freehold Patent Mining Rights Only
 - Freehold Patent Surface Rights Only
 - Right
 - Leasehold Patent Mining Rights Only
 - Leasehold Patent Surface Rights Only
 - Leasehold Patent Surface and Mining Rights
 - License of Occupation Mining Use Only
 - License of Occupation Surface Use Only
 - License of Occupation Surface and Mining Rights
 - License of Occupation Uses Not Specified
 - Order in Council
 - Trace
 - WFLA
- Geology Layers
 - AMS Data
 - AMS Features
 - Old Mines
 - Mineral Occurrences



Map Datum: NAD 83
Projection: Web Mercator



Those wishing to stake mining claims should consult with the Provincial Mining Recorders' Office of the Ministry of Northern Development and Mines for additional information on the status of the lands shown hereon. This map is not intended for navigational, survey, or land title determination purposes as the information shown on this map is compiled from various sources.
Completeness and accuracy are not guaranteed.

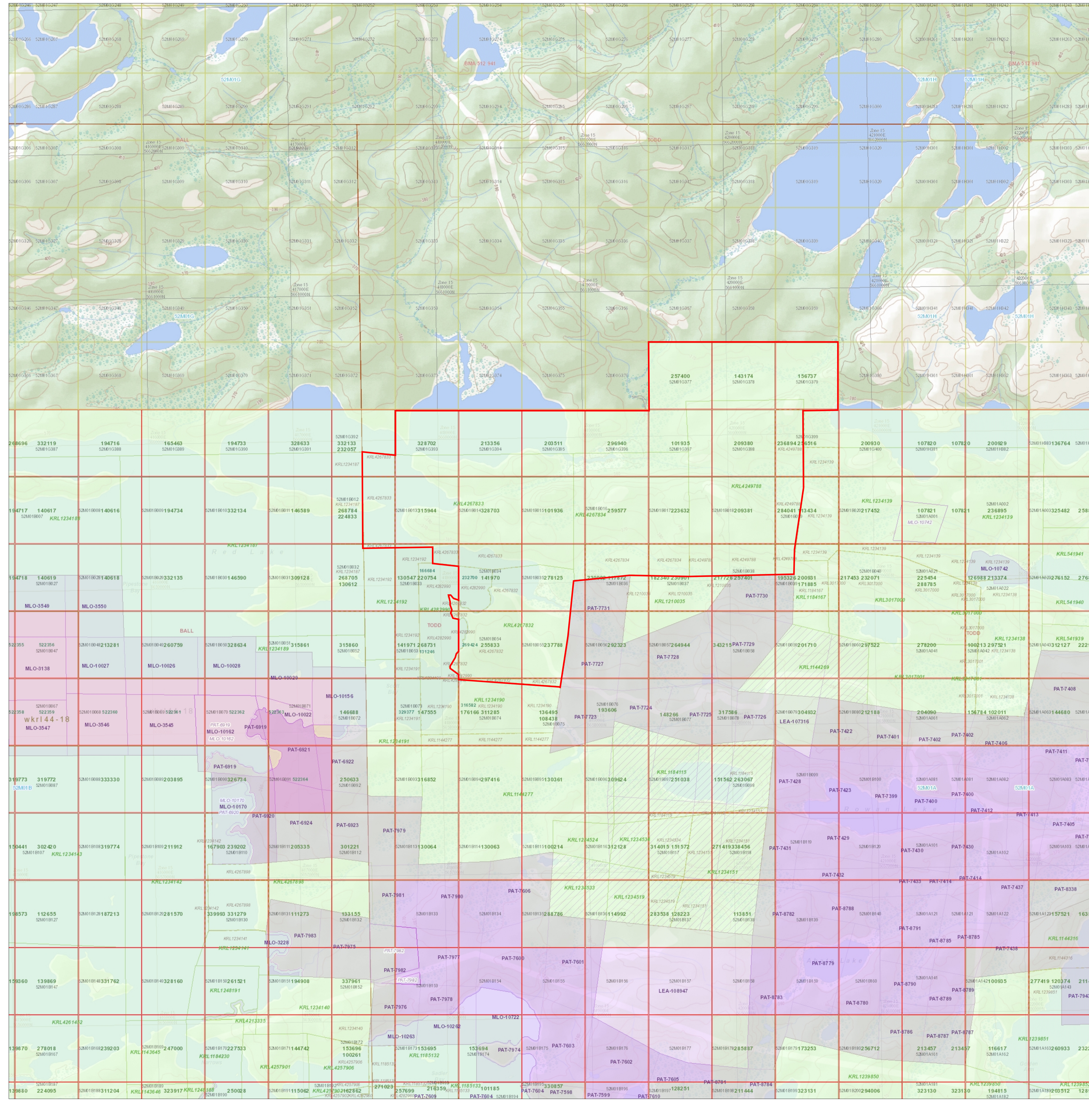
Additional information may also be obtained through the local Land Titles or Registry Office, or the Ministry of Natural Resources and Forestry.
The information shown is derived from digital data available in the Provincial Mining Recorders' Office at the time of downloading from the Ministry of Northern Development and Mines web site.
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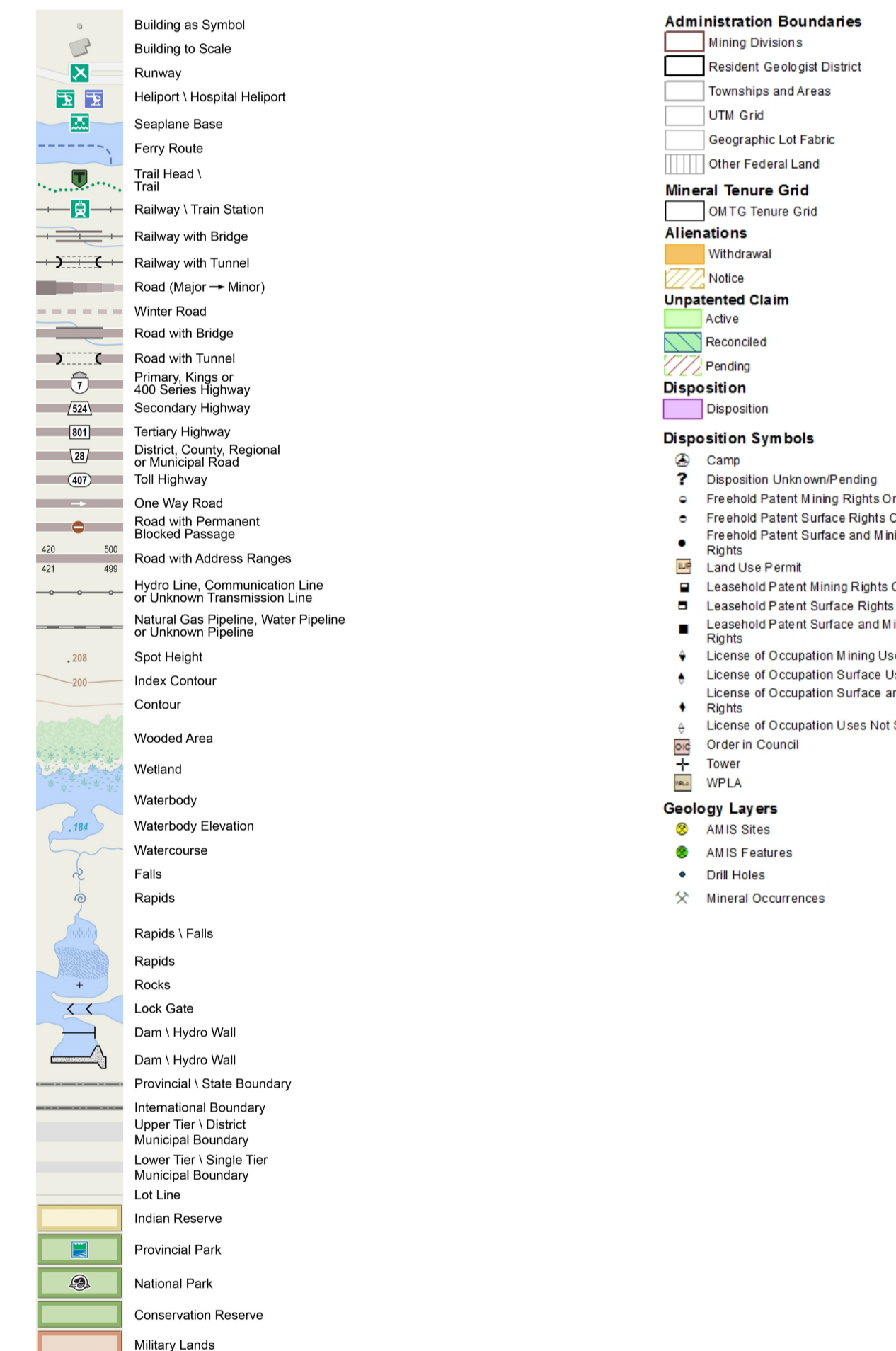
Ontario Ministry of Northern Development and Mines
Mining Lands Claim Map

Administrative Districts

Township
TODD
Mining Division
Red Lake
Land Registry
KENORA
MNR District Office



Topographic



Scale: 1:10,000



Map Datum: NAD 83
Projection: Web Mercator



Those wishing to stake mining claims should consult with the Provincial Mining Recorders' Office of the Ministry of Northern Development and Mines for additional information on the status of the lands shown hereon. This map is not intended for navigational, survey, or land title determination purposes as the information shown on this map is compiled from various sources.

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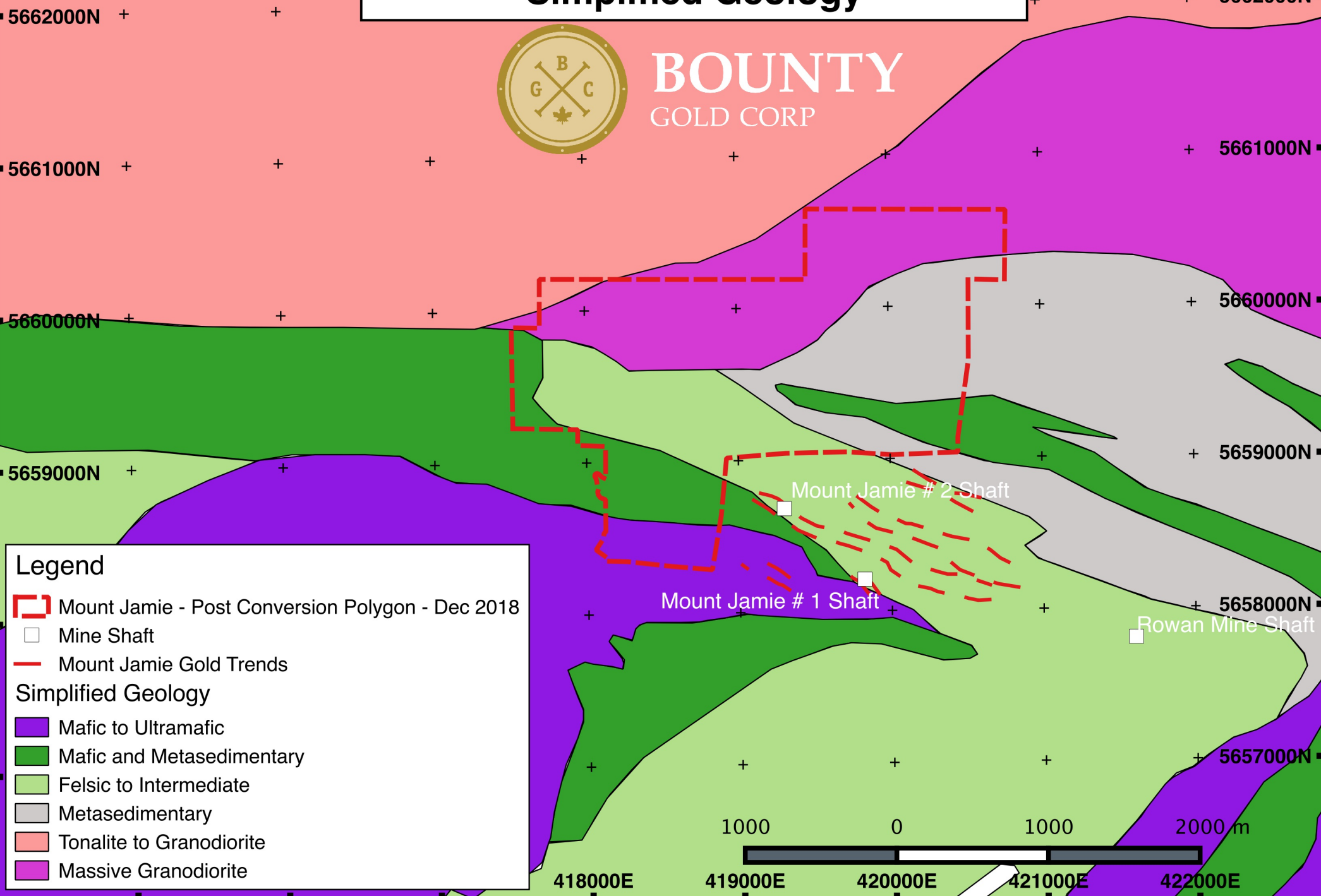
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Mount Jamie North Gold Project - Simplified Geology



BOUNTY GOLD CORP



Legend

- Mount Jamie - Post Conversion Polygon - Dec 2018
- Mine Shaft
- Mount Jamie Gold Trends

Simplified Geology

- Mafic to Ultramafic
- Mafic and Metasedimentary
- Felsic to Intermediate
- Metasedimentary
- Tonalite to Granodiorite
- Massive Granodiorite

Mount Jamie # 2 Shaft

Mount Jamie # 1 Shaft

Rowan Mine Shaft

1000 0 1000 2000 m

418000E 419000E 420000E 421000E 422000E

5662000N + + 5662000N

5661000N + + 5661000N

5660000N + + 5660000N

5659000N + + 5659000N

5658000N + + 5658000N

5657000N + + 5657000N



BOUNTY
GOLD CORP.

Mount Jamie North Gold Project - 2018 Sampling

417000

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419000

420000

421000

5661000

5661000

5660000

5660000

5659000

5658000

1000

0

1000

2000 m

417000

418000

419000

420000

Legend

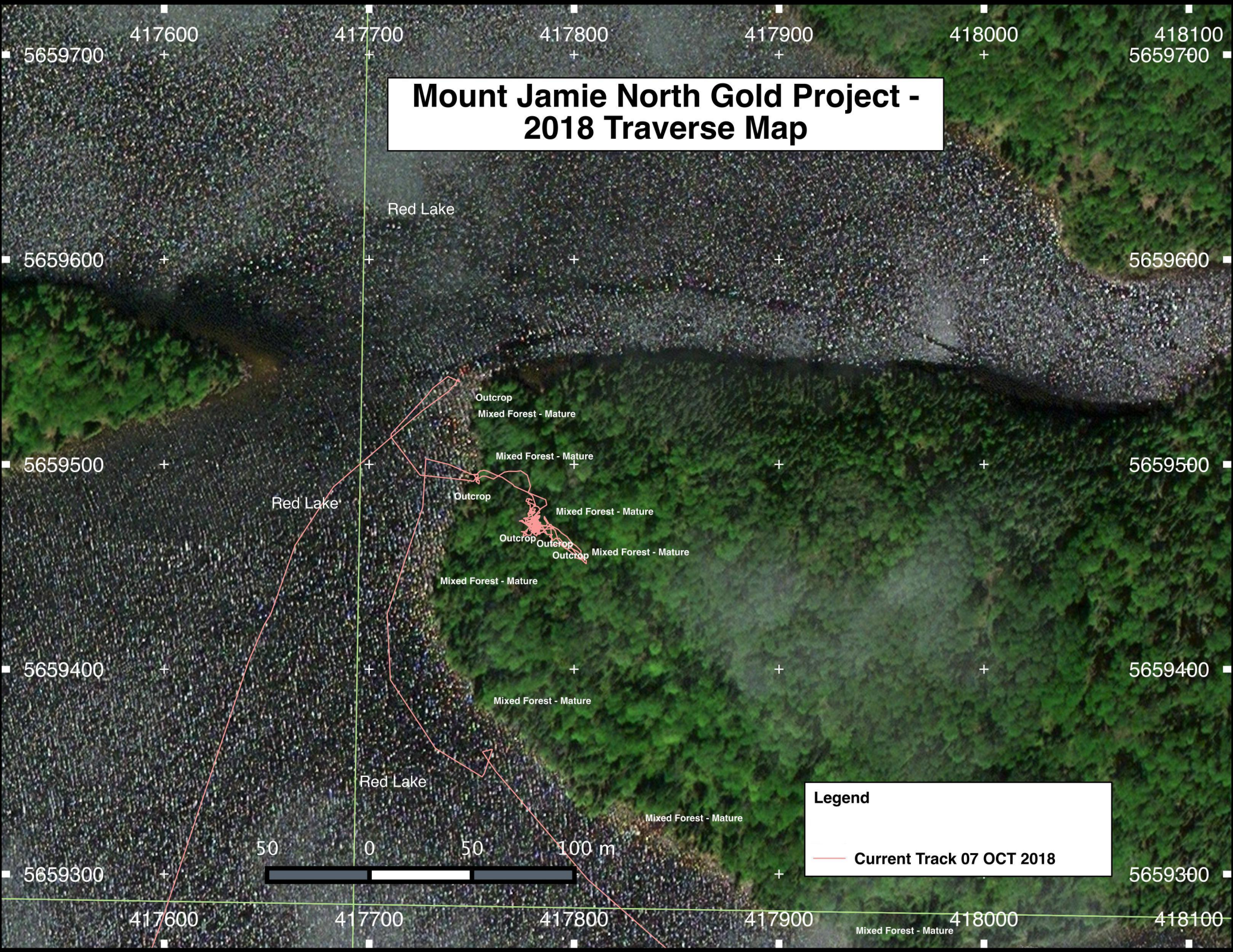
- Mount Jamie North Claim Outline
- Mine Shaft
- Mount Jamie Gold Trends
- Mount Jamie 2018 Samples (ppb Au)**
- 5 - 50
- 50 - 100
- 100 - 200
- 200 - 300
- 300 - 400
- 400 - 500
- 500 - 600
- 600 - 700
- 700 - 800
- 800 - 1500
- Current Track 07 OCT 2018

Mount Jamie # 2 Shaft

Mount Jamie # 1 Shaft



Mount Jamie North Gold Project - 2018 Traverse Map

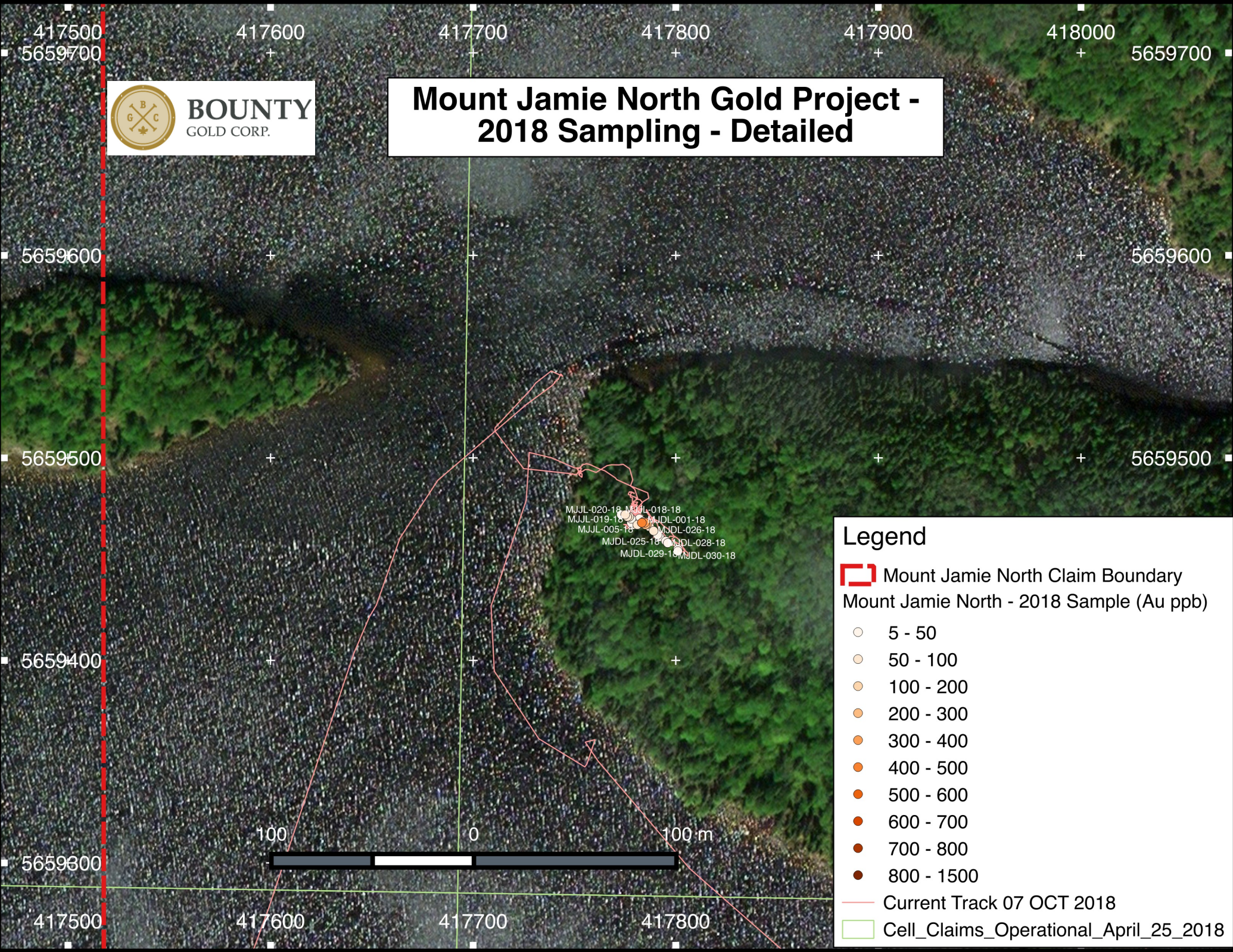


Legend

— Current Track 07 OCT 2018



Mount Jamie North Gold Project - 2018 Sampling - Detailed



MJL-020-18 MJL-018-18
MJL-019-18 MJL-001-18
MJL-005-18 MJL-026-18
MJDL-025-18 MJDL-028-18
MJDL-029-18 MJDL-030-18

Legend

- Mount Jamie North Claim Boundary
- Mount Jamie North - 2018 Sample (Au ppb)
 - 5 - 50
 - 50 - 100
 - 100 - 200
 - 200 - 300
 - 300 - 400
 - 400 - 500
 - 500 - 600
 - 600 - 700
 - 700 - 800
 - 800 - 1500
- Current Track 07 OCT 2018
- Cell_Claims_Operational_April_25_2018



Appendix E – Assay Certificates



Certificate of Analysis
Work Order : RL1802688
[Report File No.: 0000029839]

Date: October 26, 2018

To: CHRIS LEBLANC
NORTHERN WATERWORKS INC
 BOX 1160
 104 HOWEY ST
 RED LAKE ON P0V 2M0

P.O. No.: BOUNTY GOLD CORP PO# Mount Jamie North G
Project No.: -
Samples: 51
Received: Oct 22, 2018
Pages: Page 1 to 3
 (Inclusive of Cover Sheet)

Methods Summary

<u>No. Of Samples</u>	<u>Method Code</u>	<u>Description</u>
51	G_WGH79	Sample Weight & Reporting of weights
51	G_PRP89	Weigh, Dry (<3kg), Crush to 75% 2mm, Split 250g, Pulv to 85% 75 micron
51	G_CRU21	Crush to 75% passing 2mm
51	G_PUL46	Pulverize 500g, Cr steel, 75 microns, 85% passing
51	GE_FAA515	Au, FAS, AAS, 50g-5ml
51	GO_FAG505	Au, FAS, Gravimetric, 50g
51	GE_IC40M	Package, ICPAES and ICPMS after Multi-Acid Digest
51	GO_XRF76V	Meta/Tetraborate fusion, XRF (0.5g)

Comments:

ICM12B package

Certified By : _____

Report Footer: L.N.R. = Listed not received I.S. = Insufficient Sample
 n.a. = Not applicable -- = No result
 *INF = Composition of this sample makes detection impossible by this method
 M after a result denotes ppb to ppm conversion, % denotes ppm to % conversion
 Methods marked with an asterisk (e.g. *NAA08V) were subcontracted
 Elements marked with the @ symbol (e.g. @Cu) denote assays performed using accredited test methods

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Element Method Det.Lim. Units	WtKg	Au@	Au@
	G_WGH79 0 kg	GE_FAA515 5 ppb	GE_FAA515 0.005 g/t
MJDL-001-18	1.36	29	0.029
MJDL-002-18	1.26	9	0.009
MJDL-003-18	1.03	98	0.098
MJDL-004-18	0.75	19	0.019
MJDL-005-18	0.97	31	0.031
MJDL-006-18	0.84	273	0.273
MJDL-007-18	1.07	7	0.007
MJDL-008-18	0.98	212	0.212
MJDL-009-18	1.64	88	0.088
MJDL-010-18	1.56	374	0.374
MJDL-011-18	1.51	59	0.059
MJDL-012-18	1.20	23	0.023
MJDL-013-18	1.48	43	0.043
MJDL-014-18	1.68	158	0.158
MJDL-015-18	0.96	43	0.043
MJDL-016-18	0.47	45	0.045
MJDL-017-18	0.85	127	0.127
MJDL-018-18	1.21	406	0.406
MJDL-019-18	0.86	33	0.033
MJDL-020-18	0.53	28	0.028
MJDL-021-18	0.45	14	0.014
MJDL-022-18	2.05	20	0.020
MJDL-023-18	0.99	68	0.068
MJDL-024-18	0.97	100	0.100
MJDL-025-18	1.36	<5	<0.005
MJDL-026-18	0.89	<5	<0.005
MJDL-027-18	2.09	<5	<0.005
MJDL-028-18	1.17	<5	<0.005
MJDL-029-18	1.23	<5	<0.005
MJDL-030-18	1.03	34	0.034
MJDL-031-18	1.62	340	0.340
MJJL-001-18	2.24	59	0.059
MJJL-002-18	1.76	7	0.007
MJJL-003-18	1.45	7	0.007
MJJL-004-18	1.06	33	0.033
MJJL-005-18	1.45	40	0.040
MJJL-006-18	1.37	24	0.024
*Dup MJJL-006-18	--	26	0.026
MJJL-007-18	1.51	42	0.042
MJJL-008-18	0.97	20	0.020

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Element Method Det.Lim. Units	WtKg	Au@	Au@
	G_WGH79 0 kg	GE_FAA515 5 ppb	GE_FAA515 0.005 g/t
MJJL-009-18	1.29	9	0.009
MJJL-010-18	1.47	6	0.006
MJJL-011-18	0.65	12	0.012
MJJL-012-18	1.71	81	0.081
MJJL-013-18	0.42	14	0.014
MJJL-014-18	1.74	75	0.075
MJJL-015-18	0.59	62	0.062
MJJL-016-18	0.78	57	0.057
MJJL-017-18	1.70	43	0.043
MJJL-018-18	1.97	44	0.044
MJJL-019-18	1.64	15	0.015
MJJL-020-18	1.64	12	0.012
*Rep MJDL-011-18		51	0.051
*Rep MJJL-004-18		47	0.047

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Certificate of Analysis
Work Order : RL1802688
[Report File No.: 0000032947]

Date: November 29, 2018

To: Jason LeBlanc
NORTHERN WATERWORKS INC
BOX 1160
104 HOWEY ST
RED LAKE ON P0V 2M0

P.O. No.: Bounty Gold Corp /Mount Jamie North Gold
Project No.: -
Samples: 51
Received: Oct 26, 2018
Pages: Page 1 to 19
(Inclusive of Cover Sheet)

Methods Summary

<u>No. Of Samples</u>	<u>Method Code</u>	<u>Description</u>
51	G_LOG02	Pre-preparation processing, sorting, logging, boxing
51	GO_XRF76V	Ore grade Borate fusion, XRF
51	ZMS_ICM40B	Package - GE_ICM40B (GE_IC40A+GE_IC40M)
51	GE_IC40A	Multi-acid (4-acid) digestion/ICP-AES finish
51	GE_IC40M	Multi-acid (4-acid) digestion/ICP-MS finish

Storage: Pulp & Reject

PULP STORAGE : PAID STORE AFTER 90 DAYS

Comments:

REE values are informational only.

Certified By :

Gerald Chik
Operations Manager/Chief Chemist

SGS Minerals Services Geochemistry Vancouver conforms to the requirements of ISO/IEC 17025 for specific tests as listed on their scope of accreditation which can be found at <http://www.scc.ca/en/search/palcan/sgs>

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n.a. = Not applicable

I.S. = Insufficient Sample
-- = No result

*INF = Composition of this sample makes detection impossible by this method
M after a result denotes ppb to ppm conversion, % denotes ppm to % conversion

Methods marked with an asterisk (e.g. *NAA08V) were subcontracted

Elements marked with the @ symbol (e.g. @Cu) denote assays performed using accredited test methods

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Element Method Det.Lim. Units	@LOI	@SiO2	@Al2O3	@Fe2O3	@MgO	@CaO	@K2O	@Na2O
	GO_XRF76V	GO_XRF76V	GO_XRF76V	GO_XRF76V	GO_XRF76V	GO_XRF76V	GO_XRF76V	GO_XRF76V
	-10.000 %	0.01 %	0.01 %	0.01 %	0.01 %	0.01 %	0.01 %	0.01 %
MJDL-001-18	5.56	46.2	6.98	9.46	22.8	9.01	0.03	0.22
MJDL-002-18	5.57	45.0	7.96	9.75	22.7	8.33	0.04	0.22
MJDL-003-18	4.97	44.4	9.03	10.7	21.4	8.46	0.06	0.36
MJDL-004-18	4.73	47.3	7.12	9.50	21.4	9.53	0.05	0.31
MJDL-005-18	6.07	42.4	9.16	11.6	21.7	8.00	0.07	0.36
MJDL-006-18	7.13	39.1	7.43	16.9	21.2	7.06	0.05	0.18
MJDL-007-18	5.59	44.3	8.56	9.75	22.1	8.64	0.08	0.34
MJDL-008-18	7.45	37.6	6.97	18.5	21.9	6.32	0.04	0.08
MJDL-009-18	17.3	25.2	6.18	11.0	22.9	13.9	<0.01	0.03
MJDL-010-18	8.35	33.9	6.49	24.0	21.4	4.85	0.06	0.04
MJDL-011-18	8.26	37.1	9.06	14.1	25.6	4.77	0.06	0.05
MJDL-012-18	9.29	35.7	9.97	14.3	26.0	4.10	0.05	0.03
MJDL-013-18	7.04	42.0	7.48	12.6	22.4	7.49	0.04	0.19
MJDL-014-18	11.1	31.6	6.04	15.8	28.0	4.99	<0.01	0.02
MJDL-015-18	9.61	33.0	6.11	16.6	27.1	4.78	<0.01	0.03
MJDL-016-18	12.4	28.8	6.77	15.5	26.8	6.65	<0.01	0.03
MJDL-017-18	13.4	25.0	6.64	17.2	27.0	6.07	<0.01	0.02
MJDL-018-18	19.9	18.2	4.80	14.1	24.1	13.7	<0.01	0.02
MJDL-019-18	9.59	34.7	6.37	14.9	25.8	6.53	<0.01	0.02
MJDL-020-18	10.8	35.0	4.24	11.8	25.9	9.41	<0.01	0.02
MJDL-021-18	6.91	44.3	4.08	8.83	28.6	6.52	<0.01	0.05
MJDL-022-18	10.5	37.8	4.36	10.1	30.7	5.15	<0.01	<0.01
MJDL-023-18	5.03	45.0	8.78	8.61	23.1	8.91	0.05	0.31
MJDL-024-18	7.31	37.1	8.00	16.3	22.4	7.25	0.03	0.08
MJDL-025-18	1.85	61.6	17.0	4.74	5.75	2.06	4.44	1.72
MJDL-026-18	1.77	66.3	15.7	4.12	3.95	1.72	3.84	2.05
MJDL-027-18	2.07	66.9	15.6	4.02	3.96	0.88	4.69	1.20
MJDL-028-18	3.12	58.0	14.1	7.25	9.74	2.09	4.15	0.93
MJDL-029-18	2.25	65.3	16.0	3.84	4.48	1.73	4.54	1.11
MJDL-030-18	2.57	65.5	11.8	5.34	6.52	5.34	2.46	0.19
MJDL-031-18	20.2	17.9	4.52	13.7	24.0	14.4	<0.01	<0.01
MJJL-001-18	8.41	42.0	4.20	9.08	29.4	6.27	<0.01	0.01
MJJL-002-18	2.71	47.2	8.44	12.0	17.8	10.5	0.09	0.59
MJJL-003-18	3.82	47.1	8.44	12.4	18.3	9.08	0.16	0.41
MJJL-004-18	5.07	50.6	8.92	11.8	16.7	6.01	0.27	0.18
MJJL-005-18	4.52	50.7	9.05	11.5	16.8	6.53	0.21	0.22
MJJL-006-18	4.81	49.8	8.94	12.5	16.8	7.03	0.34	0.24
*Dup MJJL-006-18	4.42	49.5	8.74	12.3	16.7	7.18	0.34	0.26
MJJL-007-18	9.00	38.0	4.45	11.1	23.3	11.3	<0.01	0.05
MJJL-008-18	4.94	46.5	6.98	10.2	20.9	8.91	0.39	0.22

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Element Method Det.Lim. Units	@LOI	@SiO2	@Al2O3	@Fe2O3	@MgO	@CaO	@K2O	@Na2O
	GO_XRF76V	GO_XRF76V	GO_XRF76V	GO_XRF76V	GO_XRF76V	GO_XRF76V	GO_XRF76V	GO_XRF76V
	-10.000	0.01	0.01	0.01	0.01	0.01	0.01	0.01
	%	%	%	%	%	%	%	%
MJJL-009-18	3.90	51.4	8.11	11.4	16.6	7.29	0.66	0.21
MJJL-010-18	2.99	48.7	8.69	12.2	16.6	9.00	0.79	0.31
MJJL-011-18	3.61	44.5	10.1	12.1	18.4	9.52	0.10	0.66
MJJL-012-18	6.18	45.2	5.62	11.4	21.5	8.94	0.06	0.19
MJJL-013-18	6.57	42.0	4.05	11.2	25.0	8.81	<0.01	0.03
MJJL-014-18	4.75	42.5	4.21	13.8	20.8	11.1	0.01	0.08
MJJL-015-18	4.99	43.2	3.98	11.6	23.3	10.1	0.01	0.06
MJJL-016-18	6.77	42.6	3.78	10.2	25.8	9.13	<0.01	0.03
MJJL-017-18	5.62	41.7	4.63	15.3	21.2	9.93	0.02	0.05
MJJL-018-18	5.13	43.3	4.92	13.9	22.2	8.94	0.02	0.05
MJJL-019-18	3.24	47.3	3.13	10.2	20.9	14.0	0.02	0.05
MJJL-020-18	3.32	45.3	4.27	11.0	19.9	14.8	0.02	0.05
*Rep MJDL-002-18	5.62	44.9	7.95	9.76	22.7	8.34	0.04	0.21
*Std OREAS45D	9.51	49.8	16.0	21.5	0.42	0.26	0.52	0.14
*Std OREAS45D	9.48	49.7	16.0	21.5	0.44	0.27	0.52	0.13
*Blk BLANK	N.A.	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
*Blk BLANK	N.A.	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01

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Element Method Det.Lim. Units	@TiO2	@MnO	@P2O5	@Cr2O3	@V2O5	Sum	@Ag	@Al
	GO_XRF76V	GO_XRF76V	GO_XRF76V	GO_XRF76V	GO_XRF76V	GO_XRF76V	GE_ICM40B	GE_ICM40B
	0.01	0.01	0.01	0.01	0.01	0	0.02	0.01
	%	%	%	%	%	%	ppm	%
MJDL-001-18	0.23	0.25	0.05	0.35	0.03	101.2	0.48	4.14
MJDL-002-18	0.26	0.28	0.03	0.42	0.03	100.6	0.89	4.75
MJDL-003-18	0.30	0.28	0.03	0.31	0.04	100.4	1.18	5.43
MJDL-004-18	0.24	0.29	0.03	0.29	0.04	100.8	1.00	4.21
MJDL-005-18	0.31	0.29	0.05	0.35	0.03	100.4	1.39	5.05
MJDL-006-18	0.25	0.28	0.09	0.51	0.03	100.2	2.80	4.22
MJDL-007-18	0.31	0.28	0.04	0.26	0.04	100.3	0.69	4.77
MJDL-008-18	0.23	0.26	0.05	0.76	0.02	100.2	3.52	4.04
MJDL-009-18	0.20	0.40	0.02	0.68	0.02	97.8	1.37	3.74
MJDL-010-18	0.21	0.20	0.04	0.71	0.03	100.2	4.90	3.73
MJDL-011-18	0.30	0.19	0.04	0.44	0.04	100.0	1.01	5.02
MJDL-012-18	0.33	0.16	0.07	0.48	0.04	100.5	0.95	5.32
MJDL-013-18	0.25	0.26	0.05	0.52	0.04	100.3	1.31	4.33
MJDL-014-18	0.19	0.25	0.03	0.63	0.03	98.7	1.02	3.51
MJDL-015-18	0.19	0.27	0.07	0.70	0.03	98.4	2.03	3.50
MJDL-016-18	0.20	0.26	0.06	0.59	0.02	98.1	1.47	3.99
MJDL-017-18	0.21	0.32	0.08	0.80	0.03	96.7	3.19	3.96
MJDL-018-18	0.14	0.34	0.03	0.57	0.02	95.8	1.47	2.79
MJDL-019-18	0.21	0.33	0.10	0.64	0.03	99.2	0.86	3.74
MJDL-020-18	0.13	0.21	0.02	0.46	0.02	98.0	1.28	2.50
MJDL-021-18	0.12	0.16	0.02	0.41	0.01	100.1	0.74	2.37
MJDL-022-18	0.14	0.17	0.02	0.47	0.01	99.4	0.57	2.58
MJDL-023-18	0.29	0.23	0.02	0.26	0.04	100.7	0.37	5.22
MJDL-024-18	0.26	0.25	0.05	0.68	0.04	99.8	1.70	4.71
MJDL-025-18	0.54	0.05	0.19	<0.01	0.02	100.0	0.14	9.33
MJDL-026-18	0.51	0.04	0.18	<0.01	<0.01	100.2	0.09	8.38
MJDL-027-18	0.46	0.03	0.18	<0.01	0.01	100.0	0.09	8.28
MJDL-028-18	0.50	0.12	0.20	0.04	0.01	100.2	0.11	7.28
MJDL-029-18	0.48	0.04	0.18	<0.01	0.02	100.0	0.06	8.17
MJDL-030-18	0.34	0.09	0.12	0.01	0.02	100.3	0.07	6.37
MJDL-031-18	0.14	0.32	0.02	0.54	0.03	95.8	2.17	2.67
MJJL-001-18	0.13	0.21	0.02	0.47	0.02	100.2	0.15	2.44
MJJL-002-18	0.27	0.41	0.03	0.16	0.03	100.3	0.80	5.00
MJJL-003-18	0.28	0.35	0.05	0.17	0.04	100.5	0.34	4.97
MJJL-004-18	0.29	0.23	0.03	0.15	0.04	100.3	0.69	5.18
MJJL-005-18	0.30	0.28	0.04	0.15	0.03	100.3	0.98	5.28
MJJL-006-18	0.30	0.32	0.04	0.14	0.04	101.2	0.59	5.14
*Dup MJJL-006-18	0.30	0.32	0.04	0.13	0.03	100.3	0.72	4.97
MJJL-007-18	0.14	0.48	0.02	0.78	0.03	98.6	2.24	2.35
MJJL-008-18	0.23	0.44	0.06	0.56	0.04	100.4	1.67	3.89

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Element Method Det.Lim. Units	@TiO2	@MnO	@P2O5	@Cr2O3	@V2O5	Sum	@Ag	@Al
	GO_XRF76V	GO_XRF76V	GO_XRF76V	GO_XRF76V	GO_XRF76V	GO_XRF76V	GE_ICM40B	GE_ICM40B
	0.01	0.01	0.01	0.01	0.01	0	0.02	0.01
	%	%	%	%	%	%	ppm	%
MJJL-009-18	0.25	0.40	0.04	0.20	0.03	100.5	0.49	4.57
MJJL-010-18	0.26	0.43	0.03	0.20	0.04	100.2	0.17	5.39
MJJL-011-18	0.33	0.57	0.03	0.12	0.05	100.1	2.17	5.74
MJJL-012-18	0.20	0.47	0.06	0.87	0.03	100.7	1.64	3.15
MJJL-013-18	0.13	0.51	0.06	0.87	0.02	99.2	1.05	2.25
MJJL-014-18	0.13	0.62	0.05	0.80	0.02	98.9	2.47	2.38
MJJL-015-18	0.12	0.58	0.04	0.92	0.02	99.0	2.26	2.21
MJJL-016-18	0.12	0.58	0.03	0.68	0.03	99.8	0.53	2.14
MJJL-017-18	0.15	0.55	0.05	0.83	0.02	100.1	1.39	2.57
MJJL-018-18	0.16	0.61	0.03	0.85	0.02	100.2	1.79	2.71
MJJL-019-18	0.10	0.64	0.03	0.47	0.02	100.1	1.00	1.71
MJJL-020-18	0.12	0.57	0.01	0.80	0.03	100.2	0.37	2.30
*Rep MJDL-015-18							2.08	3.57
*Rep MJJL-020-18							0.35	2.20
*Std OREAS45D							0.20	8.16
*Blk BLANK							<0.02	<0.01
*Blk BLANK							<0.02	<0.01
*Rep MJDL-002-18	0.26	0.28	0.03	0.42	0.04	100.6		
*Std OREAS45D	1.50	0.06	0.10	0.09	0.04	100.0		
*Std OREAS45D	1.49	0.06	0.10	0.09	0.05	99.8		
*Blk BLANK	<0.01	<0.01	<0.01	<0.01	<0.01	N.A.		
*Blk BLANK	<0.01	<0.01	<0.01	<0.01	<0.01	N.A.		

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Element Method Det.Lim. Units	@Ba	@Ca	@Cr	@Cu	@Fe	@K	@Li	@Mg
	GE_ICM40B 1 ppm	GE_ICM40B 0.01 %	GE_ICM40B 1 ppm	GE_ICM40B 0.5 ppm	GE_ICM40B 0.01 %	GE_ICM40B 0.01 %	GE_ICM40B 1 ppm	GE_ICM40B 0.01 %
MJDL-001-18	11	6.62	2450	14.5	6.35	0.03	4	14.1
MJDL-002-18	22	6.16	2150	7.8	6.64	0.03	6	14.3
MJDL-003-18	38	6.10	1720	1.1	7.24	0.05	15	13.4
MJDL-004-18	26	6.97	1640	21.9	6.49	0.05	7	13.6
MJDL-005-18	117	5.81	2350	20.2	7.89	0.06	6	13.6
MJDL-006-18	75	4.93	3380	43.2	11.4	0.05	3	12.6
MJDL-007-18	38	6.26	1730	19.2	6.66	0.08	6	13.6
MJDL-008-18	16	4.24	4750	50.2	12.0	0.03	1	13.7
MJDL-009-18	12	10.2	4000	30.3	7.54	<0.01	1	14.2
MJDL-010-18	17	3.18	4980	61.2	>15.0	0.05	<1	13.4
MJDL-011-18	25	3.45	2810	29.3	9.59	0.06	<1	>15.0
MJDL-012-18	59	3.07	2990	31.1	9.61	0.04	<1	>15.0
MJDL-013-18	15	5.51	3250	56.8	8.48	0.03	2	14.1
MJDL-014-18	13	3.54	3610	37.5	10.5	<0.01	<1	>15.0
MJDL-015-18	33	3.26	4260	31.8	10.9	<0.01	<1	>15.0
MJDL-016-18	20	4.84	3720	67.8	10.6	<0.01	<1	>15.0
MJDL-017-18	31	4.28	4980	41.7	11.5	<0.01	<1	>15.0
MJDL-018-18	14	9.62	3760	12.8	9.34	<0.01	1	>15.0
MJDL-019-18	47	4.55	4130	35.8	10.1	<0.01	<1	>15.0
MJDL-020-18	11	6.87	3060	49.4	8.13	<0.01	1	>15.0
MJDL-021-18	40	4.74	2230	35.1	5.95	<0.01	<1	>15.0
MJDL-022-18	16	3.65	2640	43.3	6.85	<0.01	2	>15.0
MJDL-023-18	26	6.03	1460	<0.5	5.70	0.05	5	14.8
MJDL-024-18	43	5.18	4590	49.6	11.0	0.03	3	14.0
MJDL-025-18	894	1.46	30	7.4	3.58	4.04	156	3.88
MJDL-026-18	1180	1.21	20	<0.5	2.92	3.33	117	2.50
MJDL-027-18	1610	0.65	13	<0.5	2.85	4.05	122	2.50
MJDL-028-18	610	1.34	189	0.8	5.13	3.49	124	6.48
MJDL-029-18	950	1.10	27	3.5	2.68	3.84	126	2.80
MJDL-030-18	396	3.66	69	10.6	3.75	2.22	66	4.24
MJDL-031-18	7	9.84	3810	19.9	9.10	<0.01	2	14.9
MJJL-001-18	20	4.43	2720	28.0	6.10	<0.01	1	>15.0
MJJL-002-18	36	7.34	877	36.1	8.16	0.09	17	12.1
MJJL-003-18	32	6.24	1250	15.6	8.29	0.14	31	12.0
MJJL-004-18	51	4.14	919	35.6	8.07	0.25	37	11.3
MJJL-005-18	44	4.41	981	40.0	7.73	0.19	44	10.7
MJJL-006-18	104	4.68	903	61.6	8.35	0.31	41	11.4
*Dup MJJL-006-18	94	4.75	866	60.9	8.11	0.30	39	9.95
MJJL-007-18	13	6.82	4120	26.0	6.58	0.01	<1	11.7
MJJL-008-18	91	5.81	3100	27.6	6.72	0.34	12	11.9

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Element Method Det.Lim. Units	@Ba	@Ca	@Cr	@Cu	@Fe	@K	@Li	@Mg
	GE_ICM40B 1 ppm	GE_ICM40B 0.01 %	GE_ICM40B 1 ppm	GE_ICM40B 0.5 ppm	GE_ICM40B 0.01 %	GE_ICM40B 0.01 %	GE_ICM40B 1 ppm	GE_ICM40B 0.01 %
MJJL-009-18	151	4.58	1080	17.3	7.35	0.57	45	9.97
MJJL-010-18	300	6.20	1190	<0.5	8.48	0.77	52	11.0
MJJL-011-18	53	6.15	598	35.6	7.93	0.09	21	11.2
MJJL-012-18	60	5.61	4960	64.8	7.29	0.05	2	13.0
MJJL-013-18	45	5.76	4250	23.9	7.23	<0.01	<1	13.0
MJJL-014-18	16	7.19	4790	68.4	8.71	0.02	3	12.2
MJJL-015-18	31	6.55	5130	33.2	7.43	0.01	<1	12.4
MJJL-016-18	14	6.04	3300	30.4	6.74	<0.01	1	13.8
MJJL-017-18	16	6.30	4420	96.9	9.61	0.02	1	11.8
MJJL-018-18	15	5.74	4630	72.5	8.92	0.02	1	12.9
MJJL-019-18	28	9.19	2890	44.3	6.61	0.02	4	11.9
MJJL-020-18	24	9.17	4330	58.1	6.93	0.01	4	11.2
*Rep MJDL-015-18	33	3.47	4450	32.3	11.4	<0.01	1	>15.0
*Rep MJJL-020-18	23	9.09	4190	55.2	6.63	0.01	4	11.4
*Std OREAS45D	188	0.19	628	365	14.4	0.42	21	0.27
*Blk BLANK	<1	0.01	2	<0.5	<0.01	<0.01	<1	<0.01
*Blk BLANK	<1	<0.01	<1	<0.5	<0.01	<0.01	<1	<0.01

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Element Method Det.Lim. Units	@Mn	@Na	@Ni	@P	@S	@Sr	@Ti	@V
	GE_ICM40B	GE_ICM40B	GE_ICM40B	GE_ICM40B	GE_ICM40B	GE_ICM40B	GE_ICM40B	GE_ICM40B
	2 ppm	0.01 %	0.5 ppm	0.01 %	0.01 %	0.5 ppm	0.01 %	2 ppm
MJDL-001-18	1920	0.16	135	0.02	0.10	25.5	0.16	169
MJDL-002-18	2120	0.16	210	0.01	0.14	28.9	0.18	192
MJDL-003-18	2150	0.28	166	0.02	0.09	38.5	0.20	218
MJDL-004-18	2170	0.25	101	0.02	0.49	39.1	0.17	173
MJDL-005-18	2150	0.26	190	0.03	0.43	33.8	0.21	206
MJDL-006-18	2140	0.14	526	0.05	0.67	24.0	0.16	169
MJDL-007-18	2160	0.27	103	0.02	0.31	36.1	0.20	188
MJDL-008-18	1890	0.07	498	0.03	0.78	19.3	0.15	160
MJDL-009-18	3070	0.02	1320	0.01	1.55	226	0.14	155
MJDL-010-18	1550	0.03	337	0.02	0.43	11.5	0.15	163
MJDL-011-18	1500	0.02	215	0.02	0.88	15.7	0.20	219
MJDL-012-18	1340	0.02	267	0.03	0.65	16.7	0.20	213
MJDL-013-18	2060	0.13	134	0.03	0.88	27.1	0.17	200
MJDL-014-18	1970	0.02	1530	0.02	0.99	68.9	0.13	155
MJDL-015-18	2080	0.02	1350	0.04	1.18	60.1	0.13	159
MJDL-016-18	2070	0.01	1490	0.03	1.31	121	0.14	139
MJDL-017-18	2320	<0.01	1690	0.04	2.41	86.2	0.14	154
MJDL-018-18	2460	<0.01	1500	0.02	2.89	115	0.10	125
MJDL-019-18	2400	0.01	1240	0.05	0.89	39.3	0.14	156
MJDL-020-18	1640	0.02	1400	0.02	1.41	125	0.09	113
MJDL-021-18	1200	0.02	1110	0.01	0.70	25.4	0.09	107
MJDL-022-18	1380	0.01	1540	0.01	0.97	50.4	0.10	112
MJDL-023-18	1800	0.25	262	0.01	0.22	52.0	0.19	199
MJDL-024-18	1980	0.05	668	0.03	0.62	45.7	0.18	187
MJDL-025-18	421	1.29	31.5	0.11	0.01	446	0.31	87
MJDL-026-18	293	1.53	28.8	0.10	<0.01	433	0.28	77
MJDL-027-18	248	0.87	25.8	0.09	0.07	204	0.27	69
MJDL-028-18	916	0.67	177	0.10	0.06	254	0.25	90
MJDL-029-18	293	0.77	48.3	0.10	0.01	152	0.28	70
MJDL-030-18	629	0.15	51.1	0.07	0.04	220	0.21	88
MJDL-031-18	2350	0.01	1460	0.01	3.01	134	0.10	120
MJJL-001-18	1620	0.02	1460	0.01	0.33	23.1	0.09	107
MJJL-002-18	3070	0.46	145	0.02	0.29	90.3	0.19	192
MJJL-003-18	2660	0.30	101	0.03	0.07	62.9	0.16	197
MJJL-004-18	1770	0.14	64.1	0.02	0.43	36.2	0.11	205
MJJL-005-18	1980	0.17	107	0.02	0.31	33.8	0.11	209
MJJL-006-18	2260	0.19	67.9	0.03	0.25	52.3	0.13	208
*Dup MJJL-006-18	2250	0.19	67.0	0.02	0.25	53.3	0.12	222
MJJL-007-18	3090	0.03	899	0.01	1.03	132	0.09	129
MJJL-008-18	3170	0.15	94.7	0.03	0.30	123	0.14	180

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Element Method Det.Lim. Units	@Mn GE_ICM40B 2 ppm	@Na GE_ICM40B 0.01 %	@Ni GE_ICM40B 0.5 ppm	@P GE_ICM40B 0.01 %	@S GE_ICM40B 0.01 %	@Sr GE_ICM40B 0.5 ppm	@Ti GE_ICM40B 0.01 %	@V GE_ICM40B 2 ppm
MJJL-009-18	2760	0.17	142	0.02	0.07	70.1	0.15	201
MJJL-010-18	3180	0.26	234	0.01	<0.01	212	0.18	220
MJJL-011-18	4020	0.50	142	0.02	0.73	68.5	0.21	248
MJJL-012-18	3210	0.13	58.1	0.03	0.42	34.8	0.13	174
MJJL-013-18	3670	0.02	718	0.03	0.76	47.7	0.09	125
MJJL-014-18	4250	0.04	590	0.03	1.28	69.0	0.09	137
MJJL-015-18	4170	0.03	930	0.02	1.00	70.0	0.08	122
MJJL-016-18	4170	0.02	679	0.01	0.45	46.4	0.08	109
MJJL-017-18	3880	0.03	540	0.02	0.94	46.5	0.09	142
MJJL-018-18	4290	0.04	608	0.02	0.71	45.6	0.10	145
MJJL-019-18	4510	0.04	418	0.01	0.56	59.7	0.07	114
MJJL-020-18	3900	0.03	857	<0.01	0.34	65.2	0.08	138
*Rep MJDL-015-18	2100	0.03	1360	0.04	1.26	62.6	0.13	163
*Rep MJJL-020-18	3740	0.03	826	<0.01	0.31	61.8	0.07	128
*Std OREAS45D	480	0.10	224	0.05	0.04	31.2	0.82	219
*Blk BLANK	<2	<0.01	<0.5	<0.01	<0.01	<0.5	<0.01	<2
*Blk BLANK	<2	<0.01	<0.5	<0.01	<0.01	<0.5	<0.01	<2

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Element Method Det.Lim. Units	@Zn	@Zr	@As	@Be	@Bi	@Cd	@Ce	@Co
	GE_ICM40B	GE_ICM40B	GE_ICM40B	GE_ICM40B	GE_ICM40B	GE_ICM40B	GE_ICM40B	GE_ICM40B
	1	0.5	1	0.1	0.04	0.02	0.05	0.1
	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm
MJDL-001-18	73	9.6	2	<0.1	0.14	0.20	1.18	24.0
MJDL-002-18	84	6.2	1	<0.1	0.14	0.22	1.25	27.3
MJDL-003-18	92	7.7	<1	0.1	0.08	0.27	2.32	41.4
MJDL-004-18	85	5.5	1	<0.1	0.17	0.27	1.53	23.5
MJDL-005-18	104	6.9	<1	<0.1	0.15	0.18	2.46	34.6
MJDL-006-18	106	5.0	3	<0.1	0.28	0.17	1.75	70.9
MJDL-007-18	92	6.7	<1	<0.1	0.10	0.20	2.18	22.0
MJDL-008-18	119	4.0	4	<0.1	0.27	0.12	1.29	62.0
MJDL-009-18	119	2.2	2	<0.1	0.16	0.15	1.64	92.3
MJDL-010-18	102	3.6	8	<0.1	0.39	0.10	0.56	46.2
MJDL-011-18	57	3.1	1	<0.1	0.14	0.14	0.93	46.0
MJDL-012-18	63	3.8	1	<0.1	0.23	0.11	0.88	27.8
MJDL-013-18	81	4.9	1	0.1	0.22	0.20	1.63	19.0
MJDL-014-18	85	2.5	4	<0.1	0.22	0.14	1.81	102
MJDL-015-18	99	4.7	4	<0.1	0.35	0.20	1.71	98.1
MJDL-016-18	101	3.3	4	<0.1	0.26	0.18	1.75	98.1
MJDL-017-18	83	6.0	6	<0.1	0.38	0.13	1.91	140
MJDL-018-18	58	6.0	5	<0.1	0.18	0.10	2.67	99.6
MJDL-019-18	85	2.7	5	<0.1	0.20	0.19	2.41	114
MJDL-020-18	64	1.8	3	<0.1	0.27	0.22	1.62	93.9
MJDL-021-18	61	2.6	5	<0.1	0.28	0.14	1.13	67.6
MJDL-022-18	69	1.6	6	<0.1	0.24	0.09	1.41	86.1
MJDL-023-18	77	7.9	<1	0.2	0.07	0.15	2.66	32.7
MJDL-024-18	157	3.9	2	0.2	0.26	0.11	1.19	48.9
MJDL-025-18	66	134	<1	1.3	<0.04	0.03	46.31	11.7
MJDL-026-18	45	117	<1	1.2	<0.04	<0.02	36.67	11.0
MJDL-027-18	39	110	<1	1.1	<0.04	<0.02	36.22	11.3
MJDL-028-18	94	114	<1	0.8	<0.04	0.07	34.70	20.4
MJDL-029-18	29	125	<1	0.8	<0.04	0.03	53.18	10.6
MJDL-030-18	52	72.0	<1	0.6	0.04	0.12	27.62	14.3
MJDL-031-18	52	5.3	4	<0.1	0.21	0.07	2.55	98.2
MJJL-001-18	105	2.3	8	<0.1	0.12	0.07	0.70	78.1
MJJL-002-18	140	9.1	1	0.2	0.10	0.22	2.71	52.0
MJJL-003-18	116	7.8	<1	0.2	0.10	0.23	1.77	39.4
MJJL-004-18	85	5.2	<1	<0.1	0.08	0.11	1.64	29.0
MJJL-005-18	98	5.4	<1	<0.1	0.09	0.14	1.59	36.3
MJJL-006-18	120	6.2	<1	<0.1	0.10	0.15	1.83	26.5
*Dup MJJL-006-18	126	8.5	<1	<0.1	0.12	0.17	1.80	28.6
MJJL-007-18	275	2.4	1	<0.1	0.15	0.19	1.16	91.0
MJJL-008-18	323	4.8	1	<0.1	0.23	0.22	1.24	22.1

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Element Method Det.Lim. Units	@Zn	@Zr	@As	@Be	@Bi	@Cd	@Ce	@Co
	GE_ICM40B	GE_ICM40B	GE_ICM40B	GE_ICM40B	GE_ICM40B	GE_ICM40B	GE_ICM40B	GE_ICM40B
	1	0.5	1	0.1	0.04	0.02	0.05	0.1
	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm
MJJL-009-18	128	5.9	<1	<0.1	0.07	0.18	1.56	48.0
MJJL-010-18	173	6.0	<1	0.1	0.04	0.40	1.82	71.0
MJJL-011-18	429	10.8	<1	0.4	0.17	1.16	2.03	53.4
MJJL-012-18	616	4.1	2	<0.1	0.33	0.67	1.23	12.6
MJJL-013-18	431	2.6	1	<0.1	0.25	0.64	1.19	80.9
MJJL-014-18	394	3.6	<1	0.2	0.30	0.45	1.07	95.0
MJJL-015-18	361	3.0	1	<0.1	0.16	0.41	0.74	83.4
MJJL-016-18	329	2.3	3	0.1	0.17	0.27	0.98	86.6
MJJL-017-18	348	3.8	1	0.1	0.30	0.43	1.02	107
MJJL-018-18	433	4.0	2	0.1	0.25	0.55	1.01	75.1
MJJL-019-18	327	3.5	<1	0.2	0.15	0.48	1.20	67.9
MJJL-020-18	375	5.0	2	0.6	0.14	0.52	0.86	85.4
*Rep MJDL-015-18	93	5.0	4	<0.1	0.37	0.20	1.78	101
*Rep MJJL-020-18	373	4.4	<1	0.6	0.14	0.51	0.86	82.4
*Std OREAS45D	43	148	12	0.8	0.30	0.04	34.45	28.1
*Blk BLANK	<1	<0.5	<1	<0.1	<0.04	<0.02	<0.05	<0.1
*Blk BLANK	<1	<0.5	<1	<0.1	<0.04	<0.02	<0.05	<0.1

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Element Method Det.Lim. Units	@Cs	@Ga	@Hf	@In	@La	@Lu	@Mo	@Nb
	GE_ICM40B 1 ppm	GE_ICM40B 0.1 ppm	GE_ICM40B 0.02 ppm	GE_ICM40B 0.02 ppm	GE_ICM40B 0.1 ppm	GE_ICM40B 0.01 ppm	GE_ICM40B 0.05 ppm	GE_ICM40B 0.1 ppm
MJDL-001-18	<1	6.1	0.16	0.03	0.4	0.12	0.49	0.5
MJDL-002-18	<1	7.3	0.19	0.03	0.4	0.12	0.21	0.5
MJDL-003-18	<1	8.3	0.26	0.03	0.8	0.14	0.23	0.6
MJDL-004-18	<1	6.8	0.20	0.03	0.5	0.13	0.29	0.4
MJDL-005-18	<1	7.9	0.26	0.04	0.8	0.14	1.05	0.6
MJDL-006-18	<1	6.9	0.16	0.03	0.6	0.10	0.67	0.4
MJDL-007-18	<1	7.6	0.26	0.03	0.7	0.14	0.30	0.9
MJDL-008-18	<1	6.5	0.11	0.02	0.4	0.06	1.06	0.4
MJDL-009-18	<1	5.8	0.06	0.02	0.6	0.10	0.22	0.3
MJDL-010-18	<1	6.2	0.06	0.02	0.2	0.06	0.98	0.4
MJDL-011-18	<1	9.0	0.07	0.03	0.2	0.13	0.21	0.6
MJDL-012-18	<1	9.5	0.07	0.04	0.3	0.11	0.15	0.6
MJDL-013-18	<1	7.2	0.16	0.03	0.4	0.13	0.42	0.4
MJDL-014-18	<1	5.5	0.04	0.03	0.5	0.17	0.21	0.3
MJDL-015-18	<1	5.9	0.09	0.03	0.5	0.20	0.22	0.3
MJDL-016-18	<1	6.1	0.07	0.03	0.5	0.23	0.50	0.4
MJDL-017-18	<1	6.4	0.15	0.02	0.6	0.20	0.24	0.5
MJDL-018-18	<1	4.5	0.17	<0.02	0.9	0.22	0.30	0.3
MJDL-019-18	<1	6.0	0.06	0.03	0.6	0.09	0.34	0.4
MJDL-020-18	<1	4.1	0.04	0.02	0.7	0.07	0.30	0.2
MJDL-021-18	<1	4.0	0.05	<0.02	0.4	0.05	0.23	0.2
MJDL-022-18	<1	4.1	0.03	<0.02	0.6	0.05	0.16	0.3
MJDL-023-18	<1	7.3	0.27	0.04	0.8	0.16	1.59	0.5
MJDL-024-18	<1	7.7	0.13	0.02	0.5	0.12	0.39	0.4
MJDL-025-18	23	21.0	3.66	<0.02	22.0	0.11	12.37	2.6
MJDL-026-18	13	19.1	3.13	<0.02	17.1	0.09	1.22	2.4
MJDL-027-18	13	18.1	3.04	<0.02	15.2	0.09	0.59	3.3
MJDL-028-18	24	16.3	3.02	0.02	15.0	0.10	1.18	2.7
MJDL-029-18	12	19.0	3.34	<0.02	24.1	0.10	0.54	3.6
MJDL-030-18	4	12.2	1.84	0.02	11.9	0.10	1.26	1.8
MJDL-031-18	<1	4.3	0.14	<0.02	0.9	0.21	0.41	0.4
MJJL-001-18	<1	4.0	0.05	<0.02	0.3	0.05	0.17	0.3
MJJL-002-18	<1	7.6	0.30	0.03	1.0	0.15	0.37	0.4
MJJL-003-18	2	7.9	0.25	0.03	0.6	0.14	1.39	0.4
MJJL-004-18	3	8.3	0.17	0.03	0.5	0.14	0.25	<0.1
MJJL-005-18	2	8.2	0.18	0.03	0.5	0.14	0.23	0.1
MJJL-006-18	2	8.2	0.21	0.04	0.6	0.15	0.30	0.1
*Dup MJJL-006-18	2	9.1	0.27	0.04	0.6	0.15	0.44	0.7
MJJL-007-18	<1	4.5	0.07	0.02	0.6	0.08	0.86	0.2
MJJL-008-18	2	7.3	0.17	0.03	0.5	0.11	0.74	0.4

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Element Method Det.Lim. Units	@Cs GE_ICM40B 1 ppm	@Ga GE_ICM40B 0.1 ppm	@Hf GE_ICM40B 0.02 ppm	@In GE_ICM40B 0.02 ppm	@La GE_ICM40B 0.1 ppm	@Lu GE_ICM40B 0.01 ppm	@Mo GE_ICM40B 0.05 ppm	@Nb GE_ICM40B 0.1 ppm
MJJL-009-18	7	7.9	0.18	0.03	0.5	0.13	0.35	0.3
MJJL-010-18	3	9.1	0.22	0.03	0.6	0.15	1.10	0.6
MJJL-011-18	<1	9.9	0.30	0.05	0.8	0.16	1.18	0.6
MJJL-012-18	<1	5.8	0.13	0.03	0.5	0.10	4.43	0.4
MJJL-013-18	<1	4.4	0.07	<0.02	0.6	0.06	0.36	0.3
MJJL-014-18	<1	4.9	0.10	0.02	0.4	0.06	3.22	0.3
MJJL-015-18	<1	4.5	0.08	<0.02	0.3	0.06	0.31	0.2
MJJL-016-18	<1	4.1	0.07	0.02	0.4	0.08	0.44	0.2
MJJL-017-18	<1	5.2	0.09	<0.02	0.4	0.07	4.54	0.3
MJJL-018-18	<1	5.6	0.11	<0.02	0.4	0.07	1.19	0.3
MJJL-019-18	<1	3.8	0.09	<0.02	0.5	0.07	0.95	0.3
MJJL-020-18	<1	5.1	0.13	0.02	0.4	0.06	3.27	0.3
*Rep MJDL-015-18	<1	6.1	0.08	0.03	0.5	0.20	0.28	0.4
*Rep MJJL-020-18	<1	4.8	0.12	<0.02	0.4	0.05	3.02	0.3
*Std OREAS45D	4	21.1	3.81	0.10	15.8	0.19	2.41	14.7
*Blk BLANK	<1	<0.1	<0.02	<0.02	<0.1	<0.01	<0.05	<0.1
*Blk BLANK	<1	<0.1	<0.02	<0.02	<0.1	<0.01	0.05	<0.1

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Element Method Det.Lim. Units	@Pb	@Rb	@Sb	@Sc	@Se	@Sn	@Ta	@Tb
	GE_ICM40B	GE_ICM40B	GE_ICM40B	GE_ICM40B	GE_ICM40B	GE_ICM40B	GE_ICM40B	GE_ICM40B
	0.5 ppm	0.2 ppm	0.05 ppm	0.5 ppm	2 ppm	0.3 ppm	0.05 ppm	0.05 ppm
MJDL-001-18	1.4	0.3	0.10	32.6	<2	<0.3	0.09	0.16
MJDL-002-18	1.1	0.3	0.09	38.6	<2	<0.3	0.15	0.16
MJDL-003-18	1.8	1.1	0.17	44.4	<2	<0.3	0.14	0.18
MJDL-004-18	1.7	0.4	0.14	36.5	<2	<0.3	0.06	0.18
MJDL-005-18	1.9	0.4	0.18	48.6	<2	<0.3	0.07	0.16
MJDL-006-18	2.9	0.5	0.36	37.2	2	<0.3	0.06	0.14
MJDL-007-18	1.8	0.7	0.25	47.6	<2	<0.3	0.22	0.16
MJDL-008-18	4.3	0.4	0.59	35.5	4	<0.3	0.06	0.10
MJDL-009-18	2.7	<0.2	0.19	33.9	2	<0.3	<0.05	0.14
MJDL-010-18	6.4	0.8	0.82	34.2	7	<0.3	0.06	0.09
MJDL-011-18	1.3	0.9	0.11	48.0	2	<0.3	0.08	0.17
MJDL-012-18	1.1	0.5	0.13	48.9	<2	<0.3	0.10	0.14
MJDL-013-18	1.8	0.3	0.15	42.9	3	<0.3	0.06	0.15
MJDL-014-18	3.4	0.3	0.22	32.1	4	<0.3	0.06	0.22
MJDL-015-18	4.8	0.4	0.26	33.0	4	<0.3	<0.05	0.21
MJDL-016-18	6.2	0.2	0.30	26.7	4	<0.3	<0.05	0.26
MJDL-017-18	7.7	0.2	0.52	36.4	6	<0.3	0.07	0.25
MJDL-018-18	5.4	<0.2	0.34	26.3	5	<0.3	0.06	0.27
MJDL-019-18	6.6	0.3	0.52	32.3	3	<0.3	<0.05	0.15
MJDL-020-18	2.3	<0.2	0.23	23.9	3	<0.3	<0.05	0.09
MJDL-021-18	1.6	<0.2	0.17	22.4	<2	<0.3	<0.05	0.07
MJDL-022-18	1.5	0.2	0.19	24.0	<2	<0.3	<0.05	0.06
MJDL-023-18	1.5	0.3	0.11	45.8	<2	<0.3	0.09	0.19
MJDL-024-18	1.8	0.3	0.15	43.0	<2	<0.3	0.06	0.16
MJDL-025-18	11.0	137	0.06	9.1	<2	0.8	0.26	0.29
MJDL-026-18	8.1	111	0.05	7.6	<2	0.6	0.22	0.24
MJDL-027-18	6.7	115	<0.05	7.5	<2	0.6	0.30	0.23
MJDL-028-18	5.8	138	<0.05	10.0	<2	0.4	0.26	0.23
MJDL-029-18	6.0	104	<0.05	7.7	<2	0.6	0.35	0.26
MJDL-030-18	3.0	71.6	0.12	13.8	<2	0.3	0.21	0.20
MJDL-031-18	6.0	0.3	0.41	23.8	5	<0.3	0.09	0.24
MJJL-001-18	1.8	0.4	0.29	21.3	<2	<0.3	<0.05	0.07
MJJL-002-18	6.6	1.0	0.30	42.4	<2	<0.3	<0.05	0.18
MJJL-003-18	4.6	6.5	0.24	43.7	<2	<0.3	0.10	0.18
MJJL-004-18	1.2	8.1	0.09	46.1	<2	<0.3	0.06	0.17
MJJL-005-18	1.5	6.9	0.13	47.9	<2	<0.3	0.07	0.17
MJJL-006-18	2.2	12.6	0.17	47.1	<2	<0.3	0.06	0.18
*Dup MJJL-006-18	2.8	15.2	0.28	44.5	2	<0.3	0.29	0.21
MJJL-007-18	1.3	0.2	0.18	24.5	5	<0.3	0.06	0.10
MJJL-008-18	3.3	14.7	0.17	38.1	6	<0.3	0.08	0.15

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Element Method Det.Lim. Units	@Pb GE_ICM40B 0.5 ppm	@Rb GE_ICM40B 0.2 ppm	@Sb GE_ICM40B 0.05 ppm	@Sc GE_ICM40B 0.5 ppm	@Se GE_ICM40B 2 ppm	@Sn GE_ICM40B 0.3 ppm	@Ta GE_ICM40B 0.05 ppm	@Tb GE_ICM40B 0.05 ppm
MJJL-009-18	3.5	31.9	0.25	45.1	<2	<0.3	0.08	0.17
MJJL-010-18	2.6	40.1	0.21	50.1	<2	<0.3	0.18	0.19
MJJL-011-18	5.9	1.1	0.35	50.9	3	0.4	0.15	0.20
MJJL-012-18	4.2	0.5	0.11	33.6	11	<0.3	<0.05	0.13
MJJL-013-18	2.8	0.2	0.10	21.6	3	<0.3	0.05	0.09
MJJL-014-18	25.7	0.4	0.13	24.7	6	<0.3	0.09	0.09
MJJL-015-18	3.7	<0.2	0.09	25.7	4	<0.3	<0.05	0.08
MJJL-016-18	1.8	0.4	0.23	22.4	2	<0.3	<0.05	0.10
MJJL-017-18	6.4	0.4	0.10	26.1	6	<0.3	<0.05	0.09
MJJL-018-18	2.3	<0.2	0.06	27.1	5	<0.3	<0.05	0.10
MJJL-019-18	2.2	0.4	0.14	18.7	<2	<0.3	<0.05	0.11
MJJL-020-18	1.5	0.6	0.15	24.3	<2	<0.3	<0.05	0.08
*Rep MJDL-015-18	5.0	0.4	0.23	34.2	4	<0.3	0.06	0.22
*Rep MJJL-020-18	1.4	0.7	0.15	23.0	<2	<0.3	<0.05	0.08
*Std OREAS45D	22.0	39.8	0.82	52.0	2	2.6	1.20	0.37
*Blk BLANK	<0.5	<0.2	<0.05	<0.5	<2	<0.3	<0.05	<0.05
*Blk BLANK	<0.5	<0.2	<0.05	<0.5	<2	<0.3	<0.05	<0.05

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Element Method Det.Lim. Units	@Te	@Th	@Tl	@U	@W	@Y	@Yb	Pr
	GE_ICM40B	GE_ICM40B	GE_ICM40B	GE_ICM40B	GE_ICM40B	GE_ICM40B	GE_ICM40B	GE_ICM40B
	0.05 ppm	0.2 ppm	0.02 ppm	0.05 ppm	0.1 ppm	0.1 ppm	0.1 ppm	0.05 ppm
MJDL-001-18	<0.05	<0.2	<0.02	<0.05	0.2	6.6	0.7	0.22
MJDL-002-18	<0.05	<0.2	<0.02	<0.05	0.1	6.6	0.7	0.23
MJDL-003-18	<0.05	<0.2	<0.02	<0.05	0.2	7.9	0.9	0.37
MJDL-004-18	<0.05	<0.2	<0.02	<0.05	0.1	7.7	0.8	0.28
MJDL-005-18	<0.05	<0.2	<0.02	<0.05	0.3	7.3	0.8	0.35
MJDL-006-18	0.13	<0.2	0.03	<0.05	3.3	6.4	0.7	0.26
MJDL-007-18	<0.05	<0.2	<0.02	<0.05	0.5	7.5	0.9	0.35
MJDL-008-18	0.10	<0.2	0.03	<0.05	1.7	4.4	0.4	0.19
MJDL-009-18	<0.05	<0.2	0.06	<0.05	0.6	6.0	0.6	0.24
MJDL-010-18	0.15	<0.2	0.03	<0.05	4.1	4.1	0.4	0.09
MJDL-011-18	<0.05	<0.2	0.03	0.05	0.4	7.7	0.8	0.18
MJDL-012-18	<0.05	<0.2	<0.02	<0.05	0.7	6.3	0.7	0.17
MJDL-013-18	0.06	<0.2	0.02	<0.05	0.3	7.0	0.8	0.29
MJDL-014-18	<0.05	<0.2	0.06	<0.05	1.0	10.0	1.0	0.32
MJDL-015-18	0.05	<0.2	0.08	<0.05	1.1	10.3	1.2	0.28
MJDL-016-18	0.05	<0.2	0.09	<0.05	4.0	12.4	1.3	0.31
MJDL-017-18	0.11	<0.2	0.12	<0.05	3.8	11.0	1.2	0.33
MJDL-018-18	0.10	<0.2	0.07	<0.05	4.1	12.8	1.3	0.43
MJDL-019-18	<0.05	<0.2	0.06	<0.05	4.9	6.5	0.6	0.26
MJDL-020-18	0.05	<0.2	0.05	<0.05	1.5	4.0	0.4	0.22
MJDL-021-18	0.07	<0.2	0.03	<0.05	0.8	2.8	0.3	0.17
MJDL-022-18	<0.05	<0.2	0.04	<0.05	0.8	2.8	0.3	0.19
MJDL-023-18	<0.05	<0.2	<0.02	<0.05	1.2	8.3	1.0	0.40
MJDL-024-18	<0.05	<0.2	0.02	<0.05	9.7	7.0	0.7	0.20
MJDL-025-18	<0.05	7.0	0.82	1.76	8.7	6.9	0.7	5.35
MJDL-026-18	<0.05	6.2	0.61	1.55	1.1	6.2	0.6	4.09
MJDL-027-18	<0.05	6.3	0.62	1.84	1.6	5.9	0.6	3.76
MJDL-028-18	<0.05	6.7	0.82	1.43	0.7	6.4	0.6	3.73
MJDL-029-18	<0.05	7.6	0.53	1.88	9.1	6.3	0.6	5.45
MJDL-030-18	<0.05	3.6	0.37	0.91	7.3	6.0	0.6	2.89
MJDL-031-18	0.06	<0.2	0.06	<0.05	3.9	12.2	1.2	0.39
MJJL-001-18	0.05	<0.2	0.02	<0.05	1.1	2.9	0.3	0.11
MJJL-002-18	<0.05	<0.2	<0.02	<0.05	0.1	7.9	0.9	0.39
MJJL-003-18	<0.05	<0.2	0.03	<0.05	0.2	7.7	0.9	0.28
MJJL-004-18	<0.05	<0.2	0.06	<0.05	0.1	7.4	0.9	0.28
MJJL-005-18	<0.05	<0.2	0.05	<0.05	0.1	7.6	0.8	0.26
MJJL-006-18	<0.05	<0.2	0.06	<0.05	0.2	7.7	0.9	0.29
*Dup MJJL-006-18	0.10	<0.2	0.07	<0.05	0.8	8.5	0.9	0.31
MJJL-007-18	0.11	<0.2	<0.02	<0.05	0.7	4.1	0.5	0.18
MJJL-008-18	0.08	<0.2	0.08	<0.05	1.5	6.0	0.7	0.20

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Element Method Det.Lim. Units	@Te GE_ICM40B 0.05 ppm	@Th GE_ICM40B 0.2 ppm	@Tl GE_ICM40B 0.02 ppm	@U GE_ICM40B 0.05 ppm	@W GE_ICM40B 0.1 ppm	@Y GE_ICM40B 0.1 ppm	@Yb GE_ICM40B 0.1 ppm	Pr GE_ICM40B 0.05 ppm
MJJL-009-18	<0.05	<0.2	0.20	<0.05	0.2	6.4	0.7	0.26
MJJL-010-18	<0.05	<0.2	0.17	<0.05	0.5	7.5	0.9	0.29
MJJL-011-18	0.08	<0.2	<0.02	<0.05	0.4	8.3	1.0	0.32
MJJL-012-18	0.29	<0.2	<0.02	<0.05	0.7	5.0	0.6	0.21
MJJL-013-18	0.12	<0.2	0.03	<0.05	1.1	3.6	0.4	0.17
MJJL-014-18	0.19	<0.2	0.06	<0.05	76.0	3.8	0.4	0.17
MJJL-015-18	0.15	<0.2	0.05	<0.05	2.1	3.0	0.3	0.12
MJJL-016-18	0.09	<0.2	0.04	<0.05	3.5	4.1	0.5	0.15
MJJL-017-18	0.27	<0.2	0.06	<0.05	80.0	3.7	0.4	0.15
MJJL-018-18	0.17	<0.2	0.05	<0.05	30.3	4.0	0.4	0.16
MJJL-019-18	0.09	<0.2	0.03	<0.05	17.1	4.1	0.5	0.19
MJJL-020-18	0.13	<0.2	0.05	0.18	6.1	3.0	0.3	0.13
*Rep MJDL-015-18	0.05	<0.2	0.08	<0.05	1.2	10.6	1.2	0.29
*Rep MJJL-020-18	0.07	<0.2	0.05	0.18	5.3	3.0	0.3	0.13
*Std OREAS45D	<0.05	14.2	0.23	2.52	1.5	9.6	1.2	3.91
*Blk BLANK	<0.05	<0.2	<0.02	<0.05	<0.1	<0.1	<0.1	<0.05
*Blk BLANK	0.06	<0.2	<0.02	<0.05	0.1	<0.1	<0.1	<0.05

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Element Method Det.Lim. Units	Nd	Sm	Eu	Gd	Dy	Ho	Er	Tm
	GE_ICM40B	GE_ICM40B	GE_ICM40B	GE_ICM40B	GE_ICM40B	GE_ICM40B	GE_ICM40B	GE_ICM40B
	0.1 ppm	0.05 ppm	0.05 ppm	0.05 ppm	0.05 ppm	0.05 ppm	0.05 ppm	0.05 ppm
MJDL-001-18	1.2	0.51	0.13	0.84	1.21	0.25	0.83	0.11
MJDL-002-18	1.3	0.53	0.12	0.90	1.24	0.25	0.85	0.11
MJDL-003-18	1.8	0.63	0.20	1.01	1.43	0.28	0.98	0.14
MJDL-004-18	1.5	0.59	0.17	1.00	1.32	0.26	0.93	0.12
MJDL-005-18	1.6	0.53	0.26	0.85	1.33	0.27	0.96	0.13
MJDL-006-18	1.3	0.47	0.18	0.80	1.11	0.22	0.77	0.10
MJDL-007-18	1.7	0.57	0.26	0.90	1.37	0.28	1.01	0.13
MJDL-008-18	1.0	0.38	0.16	0.59	0.81	0.16	0.52	0.07
MJDL-009-18	1.2	0.46	0.13	0.78	1.08	0.22	0.76	0.10
MJDL-010-18	0.6	0.26	0.07	0.50	0.72	0.15	0.50	0.06
MJDL-011-18	1.1	0.51	0.06	0.91	1.42	0.29	1.01	0.13
MJDL-012-18	1.0	0.46	0.07	0.81	1.15	0.23	0.81	0.11
MJDL-013-18	1.4	0.54	0.15	0.88	1.26	0.26	0.88	0.12
MJDL-014-18	1.8	0.72	0.13	1.25	1.76	0.36	1.23	0.16
MJDL-015-18	1.6	0.65	0.12	1.17	1.79	0.37	1.31	0.18
MJDL-016-18	1.8	0.77	0.11	1.43	2.14	0.44	1.59	0.22
MJDL-017-18	1.9	0.79	0.14	1.40	2.04	0.42	1.45	0.19
MJDL-018-18	2.3	0.90	0.15	1.51	2.15	0.45	1.56	0.21
MJDL-019-18	1.3	0.51	0.15	0.87	1.17	0.23	0.77	0.10
MJDL-020-18	1.1	0.33	0.08	0.53	0.69	0.15	0.48	0.07
MJDL-021-18	0.8	0.25	<0.05	0.39	0.53	0.11	0.37	<0.05
MJDL-022-18	0.9	0.26	<0.05	0.37	0.49	0.10	0.35	<0.05
MJDL-023-18	1.9	0.63	0.33	1.01	1.55	0.32	1.12	0.15
MJDL-024-18	1.2	0.51	0.09	0.89	1.34	0.27	0.94	0.12
MJDL-025-18	18.7	3.06	0.90	2.38	1.56	0.26	0.80	0.10
MJDL-026-18	14.2	2.37	0.82	1.87	1.36	0.23	0.73	0.09
MJDL-027-18	12.9	2.24	0.75	1.84	1.30	0.21	0.69	0.08
MJDL-028-18	12.8	2.18	0.61	1.82	1.36	0.23	0.72	0.09
MJDL-029-18	18.1	2.81	0.75	2.10	1.38	0.23	0.71	0.09
MJDL-030-18	10.2	1.78	0.54	1.50	1.25	0.22	0.73	0.10
MJDL-031-18	2.2	0.81	0.13	1.43	1.98	0.42	1.44	0.19
MJJL-001-18	0.6	0.22	0.06	0.36	0.53	0.11	0.38	<0.05
MJJL-002-18	1.9	0.65	0.34	1.04	1.43	0.29	1.00	0.13
MJJL-003-18	1.5	0.60	0.24	0.98	1.42	0.28	0.99	0.13
MJJL-004-18	1.5	0.58	0.18	0.98	1.41	0.28	0.99	0.13
MJJL-005-18	1.4	0.56	0.21	0.93	1.36	0.27	0.97	0.13
MJJL-006-18	1.6	0.63	0.23	1.02	1.46	0.29	1.04	0.13
*Dup MJJL-006-18	1.6	0.60	0.28	1.00	1.35	0.32	0.91	0.14
MJJL-007-18	0.9	0.32	0.09	0.50	0.66	0.16	0.46	0.07
MJJL-008-18	1.1	0.45	0.21	0.73	1.00	0.23	0.67	0.11

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Element Method Det.Lim. Units	Nd	Sm	Eu	Gd	Dy	Ho	Er	Tm
	GE_ICM40B	GE_ICM40B	GE_ICM40B	GE_ICM40B	GE_ICM40B	GE_ICM40B	GE_ICM40B	GE_ICM40B
	0.1 ppm	0.05 ppm	0.05 ppm	0.05 ppm	0.05 ppm	0.05 ppm	0.05 ppm	0.05 ppm
MJJL-009-18	1.3	0.53	0.26	0.79	1.09	0.26	0.72	0.12
MJJL-010-18	1.5	0.57	0.32	0.90	1.25	0.30	0.88	0.14
MJJL-011-18	1.6	0.58	0.55	0.95	1.38	0.32	0.96	0.15
MJJL-012-18	1.1	0.45	0.24	0.67	0.85	0.19	0.55	0.09
MJJL-013-18	0.8	0.28	0.13	0.46	0.61	0.14	0.41	0.06
MJJL-014-18	0.8	0.31	0.25	0.46	0.62	0.14	0.43	0.07
MJJL-015-18	0.6	0.23	0.20	0.36	0.52	0.12	0.35	0.05
MJJL-016-18	0.8	0.30	0.17	0.48	0.71	0.16	0.48	0.07
MJJL-017-18	0.8	0.29	0.19	0.44	0.62	0.15	0.41	0.07
MJJL-018-18	0.9	0.32	0.20	0.48	0.68	0.15	0.45	0.07
MJJL-019-18	1.0	0.35	0.24	0.54	0.68	0.16	0.46	0.07
MJJL-020-18	0.6	0.24	0.21	0.36	0.51	0.12	0.34	0.06
*Rep MJDL-015-18	1.6	0.67	0.12	1.19	1.87	0.39	1.38	0.19
*Rep MJJL-020-18	0.6	0.24	0.21	0.37	0.50	0.12	0.33	0.05
*Std OREAS45D	13.6	2.80	0.52	2.52	2.24	0.40	1.35	0.18
*Blk BLANK	<0.1	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
*Blk BLANK	<0.1	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05

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WELCOME TO SGS

SGS was founded in 1878 and is recognized as the global leader in inspection, testing, verification and monitoring services for international trade in the minerals, agricultural, petroleum and consumer products sectors.

SGS operates a global network of over 2,400 offices and laboratories around the world and employees over 95,000 employees in 300+ countries.

SGS provides support to you as a strategic partner and a technical advisor. Through our unequalled global network of operations and laboratories, we deliver a broad spectrum of independent geochemical and metallurgical testing, process engineering and quality and quantification services for minerals, coal and coke, bio-fuels, non-ferrous metals, steel and steel-making raw materials, fertilizers, cement and industrial minerals.

The SGS Group has a unique depth and breadth of expertise and experience that can be accessed by clients from our global network.

USING THIS GUIDE

This guide details SGS' core competencies in analytical services and is designed to help you choose the analytical methodology that most appropriately fits your needs. It will direct you to the right methodology for the type of sample, element and species of that element you need. It also helps you select the smallest number of methods you need so you can maximize your analytical dollar.

- This guide is divided into sections based on sample grade, analysis techniques and analyte offerings. The purpose of this guide is to provide the best SGS analytical services available in our core competencies.
- This guide includes an elements and packages table on page 70 with determinative procedures highlighted. This table groups elements into analytical schemes which you can use to pick the best analytical method for your needs.

This guide outlines the most common procedures required by the geological community. Regional capabilities can differ throughout the SGS network based on available equipment and expertise. Contact your regional client services representative for details and pricing. Samples can be submitted to any analytical laboratory in the SGS network for forwarding to the most appropriate SGS testing laboratory for that sample type, element and test method. If samples have to be shipped out you will be notified prior to shipping via our quotation and then our final data reports will note where the samples were processed.

This guide represents only a small selection of the methods available at SGS. Please contact us to obtain a quote for your particular program. We can help you and supply you with an individually tailored quotation and analysis program that meets all of your needs.

DEFINITIONS

SGS' analytical services are used by a broad spectrum of clients in the mining sector - from those needing analysis for property assessment during exploration to those needing analysis of metallurgical products, to those requiring commercial analysis for trade transactions. To support these various needs, we have organized our services into categories and have included short explanations concerning the purpose of a test, its advantages and limitations. The categories carry over into our method-coding nomenclature so you can be sure to get the method that is fit for your specific purpose.

Types of analyses offered by SGS include:

- **Exploration-grade analysis** – This class of analysis is intended for large scale reconnaissance exploration programs. Typically, such programs generate rock or soil samples with low metal contents. In general, the frequency of inserted quality control materials is a minimum of 11% and methods with upper measurement limits of about 1% are used.
- **Ore-grade analysis** – This group of tests is used when analysing medium to high grade mineralized rock or core samples containing percent levels of target elements. The data from these analyses are often used for resource/reserve estimation. In general, the frequency of inserted quality control materials is a minimum of 12% and methods with select elements reaching upper limits of 30%.
- **Control-grade analysis** – Also known as process control, metallurgical support or metal accounting, the data from control-grade analyses are used to monitor or control a metallurgical or mining process. The frequency of inserted quality control materials is a minimum of 18% to a maximum of 120%. Control-grade methods can analyse samples that contain up to 100% of the target element in some cases. High precision and accuracy is achieved using control-grade methodology and can be increased with the number of assays per sample.

- **Commercial-grade analysis** – Commercial-grade analyses provide high precision and accuracy data that can be used to finalise commercial transactions. This data is used for commercial contract settlement or assay exchange (party analysis) and to settle disputes between buyers and sellers of traded commodities (umpire analysis). The frequency of inserted quality control materials is a minimum of 125%. Commercial-grade methods can analyse samples that contain up to 100% of the target element.

ROCKS TO RESULTS

For more information and a background to the topics in this guide, please refer to our publication, Rocks to Results. This book provides geoscientists with an introduction to geoanalysis and is available at www.sgs.com/geochem.

QUALITY POLICY STATEMENT

SGS is committed to customer satisfaction and providing a consistent level of quality service that sets the industry benchmark. The quality objectives that we measure and assess are:

- The delivery of high quality geochemical and mineralogical analyses of rocks, minerals, ores, and other materials in a timely manner.
- The use of methods which are suitably validated, fit-for-purpose and based on internationally recognized methods when possible.
- The use of a Quality Management System that strives to provide customer satisfaction by ensuring, through its documented policies and procedures, that all quality-related activity is clearly demonstrated, assessable and followed.

We will achieve this by:

- Being innovative and providing added-value to your product or service.
- Giving a committed team effort.
- Standardizing our processes.
- Using a Quality Management System that meets, as a minimum requirement, ISO 9001 and ISO/IEC 17025

- Employing a detailed quality audit program that ensures corporate and customer feedback.
- Utilizing a continuous improvement system.
- The clever and extensive use of quality control and quality assurance to ensure delivery that exceeds the industry benchmark.
- Providing appropriate staff training.
- Reviewing our Quality System annually.

SGS management and staff are appropriately empowered to ensure these requirements are met. All employees and contractors are familiar with the requirements of the Quality Management System, the above objectives and process outcomes. We welcome your feedback on this program.

QUALITY AND RESPONSIVENESS

SGS has an on-going intensive program to monitor quality. Supervised by dedicated quality management personnel, the program is proactively and continuously monitored. It enables us to react promptly to fluctuations in performance.

SGS labs follow a global procedure to select appropriate quality control materials. We define the specified frequency with appropriate acceptance and rejection data criteria for each of our methods. Data are monitored both short term and long term on a continuous basis. Client specific reports are generated with our SLIM (SGS Laboratory Information Management) system and are readily available. Please see our Laboratory Quality Control Summary at www.sgs.com/geochem for more details on these procedures.

This concern for quality extends to SGS' market attitude. SGS recognises that not all analytical problems can be solved with routine methodology. We value close communication with you, not only to address individual sample situations, but also to address issues confronted by the minerals industry as a whole.

The backbone of the "local" service you receive at SGS laboratories is a global quality protocol used by over 300 SGS minerals analytical laboratories. It controls procedures and methodology, data management and reporting, quality control and governing activities, service attitudes and response. Thus you are assured of a uniform, standardized response from any SGS laboratory worldwide. You can trust us and rely upon us.

CODE OF ETHICS

Integrity is the core of SGS; it is the common thread through all our activities. Our ethical compliance program is based on our Code of Integrity and Professional Conduct, and ensures that the highest standards of integrity are applied to all of our activities worldwide in accordance with international best practice. It has been approved by the SGS Board of Directors and our Operations Council and all SGS employees are trained in it yearly.

The purpose of this code is to document rules of behavior and to provide guidance in our day-to-day business. These rules apply to all employees of SGS. Our joint venture partners, agents, intermediaries, consultants and subcontractors are also required to comply with them. It is the responsibility of all of us at SGS, at all levels of our organization, to live by our code.

Our code is explained in detail on our website and can be summarized by the following common sense principles:

- Do not do anything which you know or believe to be illegal or unethical.
- Do not use any company property for your own benefit.
- Do not engage in any transaction which does not have a genuine, legitimate business purpose.
- Ask yourself whether any contemplated transaction or business practice would withstand the scrutiny of the public eye if exposed.
- Do not do anything which could require you to be untruthful.
- Seek advice when in doubt.

YOUR PARTNERSHIP WITH SGS

SGS' Centres of Excellence conform to the ISO/IEC 17025 standard and most of our major regional facilities are ISO 9001 certified. SGS provides analytical services for every stage of your project including:

- Exploration
- Developmental Studies
- Mine Production
- Shipment
- Trade
- Mine Closure

ANALYTICAL METHODS AND LIMITS

There are several distinct stages in the evaluation of a project – from a grassroots exploration (early stage) to the final stages of process/grade control at mine development and operation. At each stage, the analytical technique should be carefully considered with respect to the needs of the program. For example, grassroots exploration generally requires methods based on a partial or weak extraction followed by multi-element analysis. In contrast, analyses for a feasibility stage program generally involve a complete digestion followed by the analysis of a specific elemental suite focused on pay and penalty elements.

In the early stages of exploration, precision at low concentrations, sensitivity and cost effectiveness are usually key when defining an anomaly. Accuracy might not be as important as the ability of the method to reproduce and detect subtle anomalies above background or threshold levels. A partial or weak extraction method that is followed by multi-element scans could be acceptable at this stage.

In process or grade control situations, both accuracy and precision are critical. A total dissolution of the sample followed by the analysis of specific elements is more appropriate.

Commercial transaction assays require highly precise and accurate assays involving classical methodology. Please see page 58 for details.

In mineral analysis, the concept and application of detection limit is not defined universally nor is it governed by a regulated policy. The terminology used to describe this concept is varied, misused and often confusing. The lower limit (detection limit) is frequently used to market method capabilities but depending upon how this limit is validated and tested, this limit can be misleading. It is important when selecting a method, that all factors are considered.

- What are the elements of interest and their concentration range?
- What is the required precision at or near the concentration of the analyte of interest?
- What is the mineral composition or source of my samples and will this affect the detection limit for the elements of interest?

Method choice should not be exclusively selected based on the lower limit or without consideration of the points above. Limits must be well defined and established using rigorous studies that involve matrix equivalent samples taken through the entire method process and not simply by using a reagent or water blank. Statistical analysis must be used both to estimate

and test the lower limit at a suitable confidence level. At SGS, our laboratories take pride in our determination of method/analyte specific limits to ensure that this limit can be confidently projected across a wide range of samples and is fit for purpose.

There are many different analytical methods available in the industry. More detailed descriptions of the common analytes, grades and methods follow in this guide and can help you with method selection. A more exhaustive list of methods is available at your local laboratory. An SGS professional is also always available to assist you with analytical technique selection.

ELECTRONIC DATA AVAILABILITY

Many clients use our web-based data access tool “QLab” (<https://qlab.sgs.com>) for immediate and secure retrieval of their analytical data over the internet. QLab allows you to track the progress of samples and view information such as job status, turn-around-time, scheme/method, client-specific quality control data and the results of your analyses. To maintain the integrity of our sophisticated LIMS (Laboratory Information Management System), QLab does not access the database directly, but instead receives data transmissions on a regular basis.

REPORTING

All results are reported electronically immediately upon completion. Fax and/or hardcopy can be sent - a fee may apply. Copies of all certificates and invoices are sent via PDF email to the address you specify. Our QLab data portal, located at <https://qlab.sgs.com>, is accessible over the internet. Reporting units can be specified as ppb, ppm, g/t, % or oz/tonne (as applicable).

DATA TURNAROUND

Samples are processed at each SGS laboratory as promptly as possible. Sample batches requiring turnaround commitments outside contracted arrangements should be discussed with the appropriate laboratory client services personnel.

FEES AND PAYMENT METHODS

This List of Services outlines the range of analytical services and methods offered by SGS. Please contact us for a quote. Payment terms are strictly 30 days for approved clients. Interest at 1.5% per month will be levied on overdue accounts. If credit has not been established, advance payment is required. SGS accepts payment by Visa or MasterCard in many locations. Please inquire.

ON-SITE TESTING SERVICES

ON-SITE LABS

SGS offers integrated design, construction and management services for on-site laboratories. No matter how remote your operation, SGS services can be deployed to your site and tailored to your specific needs. SGS' on-site laboratory expertise is unparalleled in the industry, with more than 85 on-site analytical laboratories currently in operation. We apply the same principles, procedures and quality standards to our outsourced laboratories as are in practice in our commercial labs.

Allowing SGS to design, staff and operate your lab will ensure that you have at your disposal a full scope of capabilities for the fast turn-around of accurate, reliable data needed to run and optimize your plant operations. Outsourcing of mine-site laboratories allows you to allocate capital and staff more efficiently, concentrate on your core competencies and ensure that the data you base important decisions upon is accurate and consistent. The impartiality of a third party outsourcing partner ensures your results are transparent and meet regulatory reporting requirements.

The SGS Build, Own, Operate, and Maintain (BOOM) initiative is available globally to the minerals industry, and provides clients the opportunity to outsource capital re-quirements, engineering, construction, commissioning, maintenance and operation of non-core facilities to industry specialists.

MOBILE SAMPLE PREPARATION UNITS



SGS offers sample preparation services globally and has many Mobile Sample Preparation Units (MSPU) in some of the most remote locations in the world. Our MSPUs allow you to access our trusted third party sample preparation services in locations that might not otherwise be supported by laboratory facilities. An SGS-designed, staffed and operated MSPU provides a safe, efficient, and operationally robust in-field service giving you better speed to market and a competitive edge. By choosing our mobile laboratory services, you will:

- Take advantage of SGS's globally recognized technical expertise and laboratory quality management program.
- Reduce shipping delays related to transport of large volumes of samples.
- Benefit from fast turnaround and accurate, reliable geochemical and/or assay data.
- Gain flexibility by choosing the sample preparation protocol that best suits your needs.
- Gain NI 43-101/JORC defensible data with minimal operational demands on your project team.
- Allocate your financial and staff resources more effectively by focusing on the core aspects of your program.
- Pairing our MSPU services with portable technologies like hand-held XRF can provide you with a further enhanced in-field service and faster access to data for more timely decision making.

CORE LOGGING SERVICES

To maximize the return of the considerable investment in obtaining core, SGS provides expert geological exploration services for comprehensive core characterization in gold and precious metals, base metals, iron ore, coal, uranium and industrial minerals. Services may include manual logging by an experienced team of SGS geologists, and / or chemical and mineralogical data obtained by hand held XRF, NIR, or portable XRD units integrated with a MSPU and deployed at the drill site or in an SGS facility. Sampling frequencies can be flexible to project requirements.

PORTABLE XRF

Field-deployed portable XRF spectrometers (pXRF) allow you to take the instrument to the sample, rather than the sample to the instrument. This is advantageous for use in the field at mobile sample preparation laboratories (MSPUs) or in on-site laboratories where rapid semi-quantitative multi-element data can improve exploration and metallurgical process decision making. This technique is significantly influenced by sample mineralogy, particle size and sample matrix. It is best used on pulverized samples.

A variety of different screening data quality offerings are available ranging from high quality fully customized site-specific calibrations with traceable sample type standardization to lower quality generic soil/till calibrations. SGS's unique partnership with the XRF instrument vendors allows us complete access to the onboard instrument software so that we can build unique calibrations for the samples being presented from your deposit and/or mine site. The pXRF units are calibrated using reference materials manufactured from site specific samples that have been prepared to the highest quality standard and round robin tested by SGS' commercial laboratories using complete digestion and/or alkali fusion methods. These site-specific reference materials allow SGS to significantly increase the confidence of the instrument calibration protocol as they are used to compensate and adjust the protocols for natural grain size, mineralogical and matrix effects. This approach allows SGS to tailor the pXRF instrument sensitivity to project requirements.

For new exploration sites or sites without access to representative samples SGS also offers pXRF screening methods using onboard calibration monitored with commercially available Certified Reference Materials (CRM). This methodology again is best used on prepared till, soil or rock samples, but can be used as a very rough screening tool on raw samples.

EXPLORATION/SOIL PXRF PACKAGE (37 ELEMENTS)

GE PXRF73V

ELEMENTS AND LIMIT(S)

Al ₂ O ₃	1 - 68%	La	0.1 - 0.5%	Sn	0.01 - 15%
As	0.05 - 2.0%	MgO	5 - 70%	Sr	0.001 - 0.5%
Ba	0.05 - 10.0%	Mn	0.05 - 45.0%	Ta	0.01 - 0.2%
Bi	0.005 - 0.3%	Mo	0.01 - 1.5%	Te	0.01 - 0.05%
Ca	0.05 - 31.0%	Nb	0.005 - 42.0%	Th	0.005 - 0.5%
Ce	0.1 - 4.0%	Ni	0.005 - 3.0%	Ti	0.05 - 7.0%
Cl	0.1 - 4.0%	P	0.05 - 13.0%	U	0.01 - 0.2%
Co	0.05 - 0.3%	Pb	0.005 - 4.0%	V	0.05 - 10.0%
Cr	0.05 - 3.0%	Rb	0.001 - 0.1%	W	0.05 - 1.0%
Cu	0.005 - 6.0%	S	0.01 - 41.0%	Y	0.001 - 0.1%
Fe	0.05 - 67.0%	Sb	0.05 - 19.0%	Zn	0.005 - 19.0%
Ga	0.005 - 0.05%	Se	0.005 - 0.1%	Zr	0.005 - 2.5%
K ₂ O	0.1 - 15.0%	SiO ₂	1 - 100%		

For site-specific applications the elemental suites and reporting limits are established as part of the initial calibration phase of the project. SGS' site-specific calibrations and onsite pXRF setups are compliant with the JORC guidelines for the field operation of pXRF. The precision and accuracy of the site-specific calibrated pXRF method is suitable for identifying anomalous samples to aid in exploration target definition, but is not appropriate for use in resource calculations. This technique can also be used for relative metallurgical plant process control and troubleshooting but is not appropriate for metal accounting or final product characterizations.

Precious metals, Au, Ag, Pt, Pd and Rh are not available using this technique as they can be highly biased due to interelement and matrix effects that cannot be removed. Please inquire.

COMMERCIAL TESTING SERVICES

Most SGS laboratories provide exploration clients with dedicated sample preparation areas. Our Centres of Excellence dedicated to geochemical analysis are located strategically around the globe in Belo Horizonte, Chita, Johannesburg, Lakefield, Lima, Perth and Vancouver. Refer to the directory at the end of this guide for location details.

SGS analysts perform quality, multi-element analyses that target a wide variety of elements in many types of sample matrices. We are firmly committed to advancing the technologies for ICP-AES and ICP-MS.

This commitment ensures we deliver on our promise to provide benchmark-setting quality service. Your needs are unique; therefore we have both tailored analytical packages and high-level custom service offerings.

SAMPLE ADMINISTRATION

SAMPLE SUBMITTAL, COLLECTION AND PICK UP

Samples can be submitted to the nearest SGS laboratory or sample preparation facility. When your samples are transported to SGS by a third party, please send notice of shipment dispatch directly to the SGS receiving laboratory. Please record the name of the freight company, date of dispatch, waybill numbers, number of pieces and number of samples. This ensures that we can help track overdue or missing shipments.

We recommend that all sample submissions be clearly labeled. Sample submissions that are poorly labeled or packaged can incur additional sorting charges. Please ensure that your sample documents have full details of the analytical tests you request and reporting details.

All sample shipments require a sample submittal form or letter with clear instructions to avoid delays. Sample submission forms can be found on our website at www.sgs.com/geochem. Samples will not be analyzed until we have complete instructions. The minimum information required to proceed is:

- Company name and complete address.
- Contact name.

- Details for distribution of reports and invoices.
- Method codes.
- Instructions on sample preparation.
- List or range of sample numbers.
- Sample disposal / return requirements.
- Unusual sample characteristics.
- Warning if any samples are potentially hazardous.

To eliminate customs delays, please include the following information:

- Description of goods, such as “Geological sample for testing purposes only”.
- The receiving SGS laboratory will have the needed customs or quarantine certification to receive your submission promptly. Please contact the laboratory so we can provide the permit details that must be included with the transport documents prior to dispatch.
- Some national authorities require prior notification before samples can be received by certified laboratories. This includes NORM samples and International Soil Samples. SGS will facilitate this to avoid unnecessary delays in sample receipt. Please contact your local SGS representative.

Together, we can eliminate unnecessary delays and costs by using these sample submission protocols.

PKP01	Sample collection / pick up
LOG02	Pre-preparation processing, sorting, logging, boxing etc.
WGH79	Weighing of samples and reporting of weights

SAMPLE TRACKING

All SGS laboratories run sophisticated LIMS systems, the SGS SLIM, which facilitates complete tracking of analyses throughout the laboratory. SLIM directly tracks all samples from the time they are received at the preparation facility until they are sent to an SGS Centre of Excellence, analyzed and reported. For more information about this process, please ask your local SGS laboratory for the SGS Chain of Custody document.

SAMPLE RETURN, RETENTION, STORAGE AND DISPOSAL

Sample pulps will be stored for three months free of charge. Samples will be discarded after three months unless you specifically request their return. Disposal, storage and shipping costs may apply.

While SGS will take all reasonable care to protect your samples during analysis and storage, the samples shall at all times be at your risk.

RTN95	Return of rejects samples, per kg
RTN96	Return of pulp samples to client, per kg
RTR01	Retrieval and Handling of samples per hour rate
STO98	Storage of pulps, 30 day rate
STO99	Storage of rejects, 30 day rate
DIS93	Disposal of international soil samples, incineration, per kg rate
DIS94	Disposal of samples, per kg rate

SAMPLE PREPARATION (SIZE REDUCTION)

Sample preparation (also referred to as sample reduction) is the process by which a sample is crushed and pulverized for analysis. This will almost always involve sub-sampling. The right sampling method will produce a sub-sample that is representative of the total sample. Good sample reduction practice is essential to obtaining meaningful and reliable analytical data. More information is available in Rocks to Results, Chapter 4.

SGS is committed to providing dedicated sample preparation procedures at each of our locations. This involves technologically advanced equipment and, in most cases, physically separated sample processing areas for each sample type.

The crushing and pulverizing options available are varied. Your choice can depend on the sample type and the mineral that hosts the element of interest within the sample matrix. Please consult with our staff for the best possible option for your samples before starting an analytical program.

During sample reduction, there are many critical points where sample contamination can occur. One such area arises from the type of equipment used. Unfortunately, during sample reduction, contamination can never be avoided but processes are utilised to keep the level of contamination to a minimum. The levels are dependent on sample hardness, crushing and pulverizing time as well as crushing / grinding media used. Contamination levels can be measured and the table below indicates the type of levels of possible contamination from a variety of grinding media. More information is available in Rocks to Results, Chapter 4.1.

BOWL SELECTION

BOWL TYPE	SAMPLE CAPACITY	MAIN CONTAMINANT	MINOR CONTAMINANT
Standard mild steel bowl	To 3.5 kg	Fe, Cr	Mo
Cr-free steel	500 g to 1.5 kg	Fe	Mn
Zirconia	100 g	Zr, Hf	Al
Tungsten carbide	150 g	W, Co	Ta
Agate	100 g		Si

Note: Not all pulverizing bowl types are available at all locations. Please inquire.

SAMPLE PREPARATION PROCEDURES

DRYING

DRY10	Dry samples <3.0 kg, 105°C
DRY11	Dry samples >3.0 kg, 105°C, per kg rate
DRY12	Dry samples <3.0 kg, 60°C
DRY13	Dry samples >3.0 kg, 60°C, per kg rate
DRY14	Ambient temperature drying
DRY15	Dry excessively wet samples, per kg rate
DRY16	Dry and macerate vegetation
ASH01	Ashing of samples prior to analysis

CRUSHING

CRU20	Coarse crush to 3.36 mm (6 mesh)
CRU21	Crush <3.0 kg, 75% passing 2 mm
CRU22	Crush >3.0 kg, 75% passing 2 mm, per kg rate
CRU23	Crush <3.0 kg, 75% passing various mm
CRU24	Crush >3.0 kg, 75% passing various mm, per kg rate
CRU26	Crush <3.0 kg, 90% passing 2 mm
CRU27	Crush >3.0 kg, 90% passing 2 mm, per kg rate

SPLITTING

SPL25	Split into representative sub-samples by cone and quartering
SPL26	Split into representative sub-samples using riffle splitter, per kg
SPL27	Split into representative sub-samples using rotary splitter, per kg
SPL28	Split additional representative sub-samples

SCREENING - Applicable to soils and sediments

SCR30	Dry screening to -180 microns, <1 kg
SCR31	Dry screening to -180 microns, >1 kg, per kg rate
SCR32	Dry screening, various microns, <1 kg
SCR33	Dry screening, various microns, >1 kg, per kg rate

Note: Wet screening options are available. Please contact your local lab for details.

PULVERIZING

PUL45	Pulverize 250 g, Cr steel, 85% passing 75 microns
PUL46	Pulverize 500 g, Cr steel, 85% passing 75 microns
PUL47	Pulverize 1000-1500 g, Cr steel, 85% passing 75 microns
PUL48	Pulverize 1500-3000 g, Cr steel, 85% passing 75 microns
PUL49	Pulverize >3000 g, Cr steel, 85% passing 75 microns
PUL51	Pulverize 500-1500 g, mild steel, 85% passing 75 microns

Note: Samples can be pulverized in bowls made of other specialized materials if non-metallic preparation is required (e.g. tungsten carbide, zirconia, agate, etc.). Samples can also be pulverized at customer specified grain sizes (i.e. 106 or 120 microns) and % passing requirements. Please inquire.

SAMPLE REDUCTION PACKAGES

PRP85	Dry, pulverize, 75 microns, <1.5 kg
PRP86	Dry, pulverize, 75 microns, <3.0 kg
PRP87	Weigh, dry, (<1.5 kg), crush to 75% passing 2 mm, split, pulverize to 85% pass at 75 microns
PRP89	Weigh, dry, (<3.0 kg), crush to 75% passing 2 mm, split 250 g, pulverize to 85% passing 75 microns
PRP90	Weigh, dry, (<3.0 kg), crush to 90% passing 2 mm, split 250 g, pulverize to 85% passing 75 microns
PRP91	Weigh, dry, (<3.0 kg), crush to 75% passing 2 mm, split 500 g, pulverize to 85% passing 75 microns
PRP92	Weigh, dry, (<3.0 kg), crush to 90% passing 2 mm, split 500 g, pulverize to 85% passing 75 microns
PRP94	Weigh, dry, (<3.0 kg), crush to 75% passing 2 mm, split 1000 g, pulverize to 85% passing 75 microns
PRP95	Weigh, dry, (<3.0 kg), crush to 90% passing 2 mm, split 1000 g, pulverize to 85% passing 75 microns
PRP104	Weigh, dry @ 60°, (<1 kg), screen -80mesh (180µm), for soil samples

AUTOMATED SAMPLE PREPARATION

Automated sample preparation is the process by which a sample is crushed, split and pulverised mechanically in a closed system, with no human intervention. Such a system can be connected to an automated fused glass bead machine which produces a sample that is ready for analysis by XRF.

Automated sample preparation has several advantages. First, samples are prepared in a consistent reproducible fashion independent of any human habits or variability. Second, such preparation distances the operator from any hazardous materials that could be present, thus providing a much improved working environment. Third, an automated sample preparation system is much more reproducible. Finally, because the system is computer controlled, preparation parameters are traceable. Thus every sample can be tracked and all parameters pertaining to the sample preparation are recorded.

PRP72	Robotic Prep, 1 kg., reverse circulation, pulverize 106 microns
PRP73	Robotic Prep, 1 kg., drill core, pulverize 75 microns
PRP74	Robotic Prep, 3 kg., reverse circulation, pulverize 106 microns
PRP75	Robotic Prep, 3 kg., drill core, pulverize 75 microns
PRP76	Robotic Prep, 1 kg., drill core, pulverize 106 microns
PRP77	Robotic Prep, 3 kg., drill core, pulverize 106 microns

Note: This option is available only at certain locations. Samples can be prepared to a variety of mesh sizes. Please contact your local lab.

MISCELLANEOUS PROCEDURES

WSH78	Barren wash between each sample - pulverizing stage
WSH79	Barren wash between each sample - crushing stage
COM77	Compositing samples - gravimetric
COM78	Compositing samples - volumetric
RAD01T	Radiation monitoring using scintillation counter
PRP70	Dedicated preparation environment (required for NORM or asbestos-bearing samples)
QRT03	Sample quarantine and handling
WST01	Waste disposal fee

MOISTURE AND LOSS ON IGNITION (LOI)

Many materials contain volatile components or moisture. SGS has a variety of tests, including moisture (H₂O), loss on ignition (LOI) (at various temperatures) and thermogravimetric analysis (TGA), that provide reliable, qualitative and quantitative analyses of these components.

MOISTURE (H₂O)

CODE	ELEMENT	LIMIT(S)	DESCRIPTION
G PHY08D	H ₂ O-	0.1 - 100 %	Gravimetric determination at 105°C
G PHY09B	H ₂ O+	0.1 - 100 %	Penfield tube

LOSS ON IGNITION (LOI)

CODE	ELEMENT	LIMIT(S)	DESCRIPTION
G PHY01K	LOI	-10 - 100 %	Gravimetric determination at 1000°C
G PHY02V	LOI	-10 - 100 %	Multi-point TGA at client-specified temperatures

Note: Moisture and LOI can be determined at other temperatures. Please inquire.

SPECIFIC GRAVITY AND BULK DENSITY

Specific gravity is the density of a material relative to water or air. Since rocks are comprised of several distinct mineral phases, they do not have a fixed specific gravity. Instead, a rock's "bulk density" arises as a result of the percentage of each mineral phase in a sample multiplied by the specific gravity of each phase. SGS has extensive experience determining specific gravity and bulk density and we can identify the mineral phases using QEMSCAN®. Specific gravity and bulk density provide key information needed to design your processing flowsheet.

SGS can determine the specific gravity (SG) and bulk density (BD) of rocks, ores and aggregates. International standards are used to control the analysis whether the determination is done using the pycnometer, water and air measurements or the wax method. Such data can yield:

- Precise and accurate identification of mineral composition, including pay, penalty and detrimental metals.
- The most effective processing method.
- Appropriate sizing parameters for processing equipment.
- The exact weight of an ore (often required to calculate shipping and storage costs).

G PHY03V Specific gravity - pycnometer

G PHY05V Specific gravity - volumetric

G PHY14V Specific Gravity - pycnometer bottle

G PHY04V Bulk density - immersion

Note: If samples are porous, PHY04V will require a pre-preparation charge if it is necessary to coat samples with a sealant or wax coating.

PARTICLE SIZE ANALYSIS

Particle size analysis is used to determine the size classification and structural properties of an ore sample or to produce sized fractions for additional testing/analyses. SGS offers particle size analysis by wet screening, dry screening, a combination of both, or laser diffraction.

Wet screening is preferable to dry screening for materials containing a high percentage of clays which tend to agglomerate and thus give erroneous dry screening results. Dry screen tests can be performed on a variety of materials, but the sample must be free flowing and the particles separate (e.g. unagglomerated).

Often wet and dry methods are combined. Wet screening is performed to remove excessive fines then dry screening is performed to remove the oversize. Depending upon the nature of the material, dry screening, wet screening or a combination of both can be used.

Laser diffraction is recommended for very fine grained samples, as it is capable of measuring particle sizes at very low limits (0.02 microns). Laser diffraction is suitable for use with both wet and dry flows.

G PHY06V Particle size, sieve analysis (dry or wet)

G PHY07V Particle size, laser diffraction

PRECIOUS METALS

Precious metals (gold, silver and platinum group elements) can be analyzed by many techniques. Procedures for gold determination must take into account the sample type, sample concentration, purpose of the analysis, sample mineralogy and form of the gold (if known). Lead collection fire assay is considered the most definitive technique while acid digests and accelerated cyanide leaches can be effective for specific purposes. Similarly, silver can be determined by fire assay or acid digest techniques.

Please discuss your particular circumstance with an SGS chemist so you can choose the most appropriate technique. For more details, see our publication, Rocks to Results, Chapter 4.3.

Some platinum group elements (PGE) can also be determined by lead collection fire assay but this is not recommended. The six element PGE suite is best determined by nickel sulphide collection fire assay and neutron activation or ICP-MS. Sulphide-rich samples can require a reduction in sample weight to fuse properly.

Note: Lower and upper reporting limits of a given method can vary slightly among SGS laboratories due to reagent quality, access to consumables and instrument availability. Please inquire.

GOLD

EXPLORATION-GRADE ANALYSIS

FIRE ASSAY GOLD

CODE	ELEMENT	LIMIT(S)	DESCRIPTION
GE FAA313	Au	5 - 10,000 ppb	30 g, Fire assay, AAS finish
GE FAA515	Au	5 - 10,000 ppb	50 g, Fire assay, AAS finish
GE FAI313*	Au**	1 - 10,000 ppb	30 g, Fire assay, ICP-AES finish
GE FAI515*	Au**	1 - 10,000 ppb	50 g, Fire assay, ICP-AES finish
GE FAI323	Au**	5 - 10,000 ppb	30 g, Fire assay, ICP-AES finish
GE FAI525	Au**	5 - 10,000 ppb	50 g, Fire assay, ICP-AES finish
GE FAM313	Au**	1 - 2,000 ppb	30 g, Fire assay, ICP-MS finish
GE FAM515	Au**	1 - 2,000 ppb	50 g, Fire assay, ICP-MS finish

Note: *GE FAI313/515 methods use new fire assay pots to achieve lower limits. ** Pt and Pd can be included, refer to page 29.

Gold in soils and/or sediments can be determined by aqua regia digest and DIBK extraction. This is a partial leach and can require a pre-treatment such as roasting if samples contain significant sulphur bearing phases.

This gold analytical method has the following advantages:

- Use of large sample sizes (25 g - 50 g) which ensures representative results for materials exhibiting nugget effect.
- The digest used for gold can also be used for a large suite of additional elements.

GOLD BY ACID DIGESTION (AQUA REGIA)

CODE	ELEMENT	LIMIT(S)	DESCRIPTION
GE ARE145	Au	2 - 200 ppb	50 g, Aqua regia digest, DIBK extraction, AAS finish
GE ARE133	Au	0.02 - 200 ppm	25 g, Aqua regia digest, DIBK extraction, AAS finish
GE ARE155	Au	0.01 - 100 ppm	50 g, Aqua regia digest, DIBK extraction, AAS finish
GE ARM133	Au*	1 - 500 ppb	25 g, Aqua regia digest, ICP-MS finish
GE ARM155	Au*	1 - 500 ppb	50 g, Aqua regia digest, ICP-MS finish

* Note: Refer to page 36 for additional elements that can be determined by this method.

Cyanide leach procedures are used to enhance small gold anomalies during exploration and to monitor gold extraction efficiencies in metallurgical applications.

Bulk Leach Extractable Gold (BLEG) is a cyanide-based partial leach procedure that uses a large sample size (0.5 kg to 5 kg). It is used to enhance small gold anomalies during exploration. The cyanide leachate solution is extracted into an organic solvent and measured by flame AAS or ICP-MS. Our active cyanide leach packages are available with a variety of sample sizes, detection limits and finishing methods. The mini cyanide leach package is available for smaller sample sizes, allowing for faster TAT than active cyanide leach.

Other elements are also partially extracted with the cyanide leach and can be measured on request.

CYANIDE EXTRACTABLE GOLD

CODE	ELEMENT	LIMIT(S)	DESCRIPTION
GE BLE643	Au	0.1 - 1000 ppm	Hot, 30 g, Mini cyanide leach, ICP-AES or AAS finish
GE BLE61K	Au	0.02 - 100 ppm	500 g, Active cyanide leach, 24 hr solvent extraction, AAS finish
GE BLE61N	Au	1 ppb - 100 ppm	2000 g, Active cyanide leach, 24 hr solvent extraction, AAS finish

GE BLL61K	Au	0.05 ppb - 100 ppm	500 g, Active cyanide leach, 24 hr ICP-MS finish
GE BLL61N	Au	0.05 ppb - 100 ppm	2000 g, Active cyanide leach, 24 hr ICP-MS finish

The Leachwell™ tab is a proprietary product and Leachwell™ is a patented process. Accelerated cyanide leach techniques are used to determine bulk leachable gold in exploration samples using modified cyanide leach (Leachwell™). The large sample is mixed with water and Leachwell™ tabs and tumbled. The gold is extracted into DIBK and analyzed by flame AAS or ICP-MS. Other elements (Cu, Ag, Pb and Zn) are also partially extracted by the cyanide leach and can be measured on request.

ACCELERATED CYANIDE LEACH FOR GOLD

CODE	ELEMENT	LIMIT(S)	DESCRIPTION
GE LWL69J	Au	0.01 - 1,000 ppm	200 g, Accelerated cyanide leach, AAS
GE LWL69K	Au	0.01 - 1,000 ppm	500 g, Accelerated cyanide leach, AAS
GE LWL69L	Au	0.01 - 1,000 ppm	800 g, Accelerated cyanide leach, AAS
GE LWL69M	Au	0.01 - 1,000 ppm	1000 g, Accelerated cyanide leach, AAS
GE LWL69N	Au	0.01 - 1,000 ppm	2000 g, Accelerated cyanide leach, AAS

ORE-GRADE ANALYSIS

INSTRUMENTAL AND GRAVIMETRIC ANALYSIS

CODE	ELEMENT	LIMIT(S)	DESCRIPTION
GO FAA303	Au	0.01 - 100 ppm	30 g, Fire assay, AAS finish
GO FAA505	Au	0.01 - 100 ppm	50 g, Fire assay, AAS finish
GO FAI303	Au	0.01 - 100 ppm	30 g, Fire assay, ICP-AES finish
GO FAI505	Au	0.01 - 100 ppm	50 g, Fire assay, ICP-AES finish
GO FAG303	Au	0.5 - 10000 ppm	30 g, Fire assay, gravimetric finish

GO FAG505	Au	0.5 - 10000 ppm	50 g, Fire assay, gravimetric finish
GO FAG323	Au	0.01 - 100 ppm	30 g, Fire assay, AAS finish (Au) gravimetric finish (Ag)
	Ag	10 - 10000 ppm	
GO FAG525	Au	0.01 - 100 ppm	50 g, Fire assay, AAS finish (Au) gravimetric finish (Ag)
	Ag	10 - 10000 ppm	
GO FAG333	Au	0.5 - 10000 ppm	30 g, Fire assay, gravimetric finish (Au, Ag)
	Ag	10 - 10000 ppm	

SCREEN METALLIC GOLD ANALYSIS

Analytical results can be difficult to reproduce using typical sample reduction and fire assay procedures when coarse grained metallic gold is present. To address this, the sample can be analyzed using the screened metallics sample preparation and assaying procedure. This consists of:

- Screening 500g/1000g or client specified of the sample to a defined grain size, usually 75, 106 or 200 microns.
- Weighing the various fractions.
- Assaying the entire plus fraction.
- Weighing and analysing the undersize (usually in duplicate).
- Calculating and reporting of size-fraction weights, coarse and fine fraction gold content and total gold content.
- The finish technique may involve AAS, ICP-AES or gravimetric, depending upon concentration. Limits shown are based on instrument analysis. Gravimetric limits are higher, please contact us for more information.

Note: This technique requires a minimum sample of 500g. This technique can also be used for coarse grained native metals such as platinum, palladium, silver and copper.

SCREENED METALLICS

CODE	ELEMENT	LIMIT(S)	DESCRIPTION
GO FAS30K	Au	0.01 ppm	Au, Ag, screen metallics* (75/106/200), 30g. fire assay, 500g AAS/ICP/Grav
	Ag	10 ppm	
GO FAS50K	Au	0.01 ppm	Au, Ag, screen metallics* (75/106/200), 50g. fire assay, 500g AAS/ICP/Grav
	Ag	10 ppm	
GO FAS30M	Au	0.01 ppm	Au, Ag, screen metallics* (75/106/200), 30g. fire assay, 1000g AAS/ICP/Grav
	Ag	10 ppm	
GO FAS50M	Au	0.01 ppm	Au, Ag, screen metallics* (75/106/200), 50g. fire assay, 1000g AAS/ICP/Grav
	Ag	10 ppm	
GO FAS30V	Au	0.01 ppm	Au, Ag, screen metallics* (75/106/200), 30g. fire assay, >1000g AAS/ICP/Grav
	Ag	10 ppm	
GO FAS50V	Au	0.01 ppm	Au, Ag, screen metallics* (75/106/200), 50g. fire assay, >1000g AAS/ICP/Grav
	Ag	10 ppm	

Note: *options for screen sizes available. Pt, Pd can be added.
Finish technique is based on concentration.

CONTROL AND CONCENTRATE-GRADE ANALYSIS**INSTRUMENTAL AND GRAVIMETRIC ANALYSIS**

CODE	ELEMENT	LIMIT(S)	DESCRIPTION
GC FAA35V	Au	0.02 ppm	Variable wt, Fire assay, AAS finish
GC FAI34V	Au	0.02 ppm	Variable wt, Fire assay, ICP-AES finish
GC FAG323	Au	0.02 ppm	30 g, Fire assay, AAS finish (Au)
	Ag	10 ppm	30 g, Fire assay, gravimetric finish (Ag)
GC FAG333	Au	0.5 ppm	30 g, Fire assay, gravimetric finish (Au, Ag)
	Ag	10 ppm	

GOLD IN PROCESS SOLUTIONS

CODE	ELEMENT	LIMIT(S)	DESCRIPTION
GC FSA84T	Au	>0.01 mg/L	Solution, fire assay, AAS finish
GC FSI84T	Au	>0.01 mg/L	Solution, fire assay, ICP-AES finish

GOLD IN CYANIDE LIQUORS

CODE	ELEMENT	LIMIT(S)	DESCRIPTION
GC SOL81T	Au	>0.1 mg/L	CN solution, AAS finish
GC SOL81X	Au	0.01 - 50 mg/L	Solvent extraction, DIBK, AAS finish

GOLD IN CARBON

CODE	ELEMENT	LIMIT(S)	DESCRIPTION
GC FAA01V	Au	5 - 50,000 ppm	1-2 g, Fire assay, AAS finish
GC ARS12D	Au	5 - 250,000 ppm	1 g, Ash, acid digest, AAS finish
GC FAG01V	Au	5 - 100,000 ppm	1-5 g, Fire assay, gravimetric finish

GOLD BULLION

CODE	ELEMENT	LIMIT(S)	DESCRIPTION
GC BUL36V	Au	>10%	250-500 mg, Fire assay, gravimetric finish
	Ag	>0.1%	250-500 mg, Fire assay, gravimetric finish

SILVER

EXPLORATION-GRADE ANALYSIS

ACID DIGESTION - INSTRUMENTATION

CODE	ELEMENT	LIMIT(S)	DESCRIPTION
GE AAS12E	Ag	0.3 - 100 ppm	2 g, 2-Acid digest, AAS finish
GE AAS21E	Ag	0.3 - 100 ppm	2 g, 3-Acid digest, AAS finish
GE AAS42E	Ag	0.3 - 100 ppm	2 g, 4-Acid digest, AAS finish

Note: It is recommended that mineralized samples with Ag >30g/t are analyzed using the GO_AAS10D method below. Silver (Ag) can also be analyzed in many multi-element packages. Refer to page 32.

ORE-GRADE ANALYSIS

ACID DIGESTION - INSTRUMENTATION

CODE	ELEMENT	LIMIT(S)	DESCRIPTION
GO AAS10D	Ag	1 - 300 ppm	0.5 g, 2-Acid digest, AAS finish

GRAVIMETRIC ANALYSIS

CODE	ELEMENT	LIMIT(S)	DESCRIPTION
GO FAG313	Ag	10 - 10000 ppm	30 g, Fire assay, gravimetric finish
GO FAG515	Ag	10 - 10000 ppm	50 g, Fire assay, gravimetric finish
GO FAG323	Au	0.01 - 100 ppm	30 g, Fire assay, AAS finish (Au) gravimetric finish (Ag)
	Ag	10 - 10000 ppm	
GO FAG333	Au	0.5 - 10000 ppm	30 g, Fire assay, gravimetric finish (Au, Ag)
	Ag	10 - 10000 ppm	
GO FAG525	Au	0.01 - 100 ppm	50 g, Fire assay, AAS finish (Au), gravimetric finish (Ag)
	Ag	10 - 10000 ppm	

CONTROL AND CONCENTRATE-GRADE ANALYSIS

INSTRUMENTAL AND GRAVIMETRIC ANALYSIS

CODE	ELEMENT	LIMIT(S)	DESCRIPTION
GC AAS42V	Ag	1 - 1000 ppm	Variable wt, 4-acid digest, AAS finish
GC FAG323	Au	0.02 ppm	30 g, Fire assay, AAS finish (Au) gravimetric finish (Ag)
	Ag	10 ppm	
GC FAG333	Au	5 ppm	30 g, Fire assay, gravimetric finish (Au, Ag)
	Ag	10 ppm	
GC ARS12D	Ag	2 - 2,000 ppm	Carbon, 1 g, ash, acid digest, extract, AAS finish
GC BUL37V	Ag	0.1 - 30%	100 mg, Fire assay, gravimetric finish

GOLD, PLATINUM, PALLADIUM AND OTHER PRECIOUS METALS

EXPLORATION-GRADE ANALYSIS

GOLD, PLATINUM AND PALLADIUM

CODE	ELEMENT	LIMIT(S)	DESCRIPTION
GE FAI313*	Au	1 - 10,000 ppb	30 g, Fire assay, ICP-AES finish
	Pt	10 - 10,000 ppb	
	Pd	1 - 10,000 ppb	
GE FAI515*	Au	1 - 10,000 ppb	50 g, Fire assay, ICP-AES finish
	Pt	10 - 10,000 ppb	
	Pd	1 - 10,000 ppb	
GE FAM313	Au	1 - 2,000 ppb	30 g, Fire assay, ICP-MS finish
	Pt	0.5 - 2,000 ppb	
	Pd	0.5 - 2,000 ppb	

GE FAM515	Au	1 - 2,000 ppb	50 g, Fire assay, ICP-MS finish
	Pt	0.5 - 2,000 ppb	
	Pd	0.5 - 2,000 ppb	
GE FAI323	Au	5 - 10,000 ppb	30 g, Fire assay, ICP-AES finish
	Pt	10 - 10,000 ppb	
	Pd	5 - 10,000 ppb	
GE FAI525	Au	5 - 10,000 ppb	50 g, Fire assay, ICP-AES finish
	Pt	10 - 10,000 ppb	
	Pd	5 - 10,000 ppb	

Note: *GE FAI313/515 methods use new fire assay pots to achieve lower limits.

PLATINUM GROUP ELEMENTS

CODE	ELEMENT	LIMIT(S)	DESCRIPTION
GE NAA363	Pt	0.02 - 10 ppm	30 g, Fire assay nickel sulphide collection, NAA (neutron activation) finish
	Pd	0.02 - 10 ppm	
	Rh	0.005 - 10 ppm	
	Ru	0.05 - 10 ppm	
	Ir	0.001 - 10 ppm	
	Os	0.01 - 10 ppm	

Note: This method is not available in all SGS laboratories; please contact us for more information.

ORE-GRADE ANALYSIS

GOLD, PLATINUM AND PALLADIUM

CODE	ELEMENT	LIMIT(S)	DESCRIPTION
GO FAI303	Au	0.01 - 100 ppm	30 g, Fire assay, ICP-AES finish
	Pt	0.01 - 100 ppm	
	Pd	0.01 - 100 ppm	
GO FAI505	Au	0.01 - 100 ppm	50 g, Fire assay, ICP-AES finish
	Pt	0.01 - 100 ppm	
	Pd	0.01 - 100 ppm	

PLATINUM GROUP ELEMENTS

CODE	ELEMENT	LIMIT(S)	DESCRIPTION
GO FAM363 and/or GO NAA363	Pt	0.02 ppm	30 g, Fire assay nickel sulphide collection, ICP-MS or NAA finish
	Pd	0.02 ppm	
	Rh	0.02 ppm	
	Ru	0.05 ppm	
	Ir	0.04 ppm	
	Os	0.05 ppm	

Note: Samples can be analyzed by ICP-MS or sent for neutron activation. This method is not available in all SGS laboratories; please contact us for more information.

CONTROL-GRADE ANALYSIS

GOLD, PLATINUM AND PALLADIUM

CODE	ELEMENT	LIMIT(S)	DESCRIPTION
GC FAI34V	Au	0.02 ppm	Variable wt, Fire assay, ICP-AES finish
	Pt	0.02 ppm	
	Pd	0.02 ppm	

PLATINUM GROUP ELEMENTS

CODE	ELEMENT	LIMIT(S)	DESCRIPTION
GC FAM363 and/or GC NAA363	Pt	0.02 ppm	30 g, Fire assay nickel sulphide collection, ICP-MS or NAA finish
	Pd	0.02 ppm	
	Rh	0.02 ppm	
	Ru	0.05 ppm	
	Ir	0.04 ppm	
	Os	0.05 ppm	

Note: Samples can be analyzed by ICP-MS or sent for neutron activation. This method is not available in all SGS laboratories; please contact us for more information.

EXPLORATION-GRADE ANALYSIS

MULTI-ELEMENT, TRACE ICP-AES AND ICP-MS PACKAGES

A variety of approaches can be used for exploration analysis depending on your needs. In every case, each approach consists of a digestion technique and an instrumentation technique or “finish”. Each combination provides a unique suite of elements and specific upper and lower reporting limits.

SAMPLE DECOMPOSITION / DIGESTION

Sample digestion is the most important parameter to consider when choosing an analytical method. There are several types of digestion available, including:

- Aqua regia digestion.
- Multi-acid (two, three or four acid) digestion.
- Sodium peroxide fusion.
- Lithium metaborate fusion.

Rocks to Results also provides more details in Chapter 4.2.

Typically, reconnaissance exploration-grade samples (including regional soil samples) are analyzed by aqua regia digestion followed by a multi-element ICP-AES or ICP-MS scan for base metals, trace and lithological elements.

Drill-core and rock samples are generally analyzed by multi-acid or fusion digestion, with a multi-element finish. Where metal contents are high (or ore-grade), samples can require further testing or other methods to ensure data is precise and accurate enough for regulatory reporting. Refer to the Ore-Grade Analysis section in this guide.

INSTRUMENTATION

ICP-AES and ICP-MS are the most widely used geoanalytical instrumentation techniques because they yield many elements concurrently. These instruments are widely accepted in the mineral exploration industry as rapid and cost-effective means of analysis. Other instruments that can be used are AAS (Atomic Absorption Spectrophotometer) and Hydride AAS.

TWO-ACID / AQUA REGIA DIGESTION PACKAGES

The following packages are based on a two-acid digest (a combination of HNO₃ and HCl). After the digestion, the solution is analyzed by either ICP-AES or ICP-MS or both. We can also analyze these digestions by Hydride AAS to determine the hydride forming elements (Hg, Sb, As, Bi, Se, Te). Two-acid digests are the weakest of the digestions and will not attack silicate minerals. As such, the leach provides partial results for most elements.

The methods listed below with the designation “12” are based on a combination of 2:1 HNO₃ : HCl. This digest is recommended for samples with organic or high sulphide mineral content*.

The methods listed below with the designation “14” are based on a combination of 3:1 HCl : HNO₃. This is an aqua regia digest and is recommended for all samples which contain no organic material and are low in sulphide mineral content.

All elements and limits are identical in the “12” and “14” digests.

NOTE: Requires a minimum sample weight of 0.5g. Detection and upper limits can vary slightly among SGS laboratories because some laboratories may not have access to high purity reagents and consumables and/or they have slight differences in instrumentation. Please talk with your local lab manager to make sure you get the reporting limits you need.

*High sulphide mineral content is defined as over 10%.

TWO ACID / AQUA REGIA DIGESTION / ICP-AES PACKAGE (34 ELEMENTS)

GE ICP12B or GE ICP14B

ELEMENTS AND LIMIT(S)

Ag	2 - 100 ppm*	Hg	1 - 10000 ppm	Sb	5 - 10000 ppm
Al	0.01 - 15%	K	0.01 - 15%	Sc	0.5 - 10000 ppm
As	3 - 10000 ppm	La	0.5 - 10000 ppm	Sn	10 - 10000 ppm
Ba	5 - 10000 ppm	Li	1 - 10000 ppm	Sr	0.5 - 10000 ppm
Be	0.5 - 2500 ppm	Mg	0.01 - 15%	Ti	0.01 - 15%
Bi	5 - 10000 ppm	Mn	2 - 10000 ppm	V	1 - 10000 ppm
Ca	0.01 - 15%	Mo	1 - 10000 ppm	W	10 - 10000 ppm
Cd	1 - 10000 ppm	Na	0.01 - 15%	Y	0.5 - 10000 ppm
Co	1 - 10000 ppm	Ni	1 - 10000 ppm	Zn	1 - 10000 ppm

Cr	1 - 10000 ppm	P	0.01 - 15%	Zr	0.5 - 10000 ppm
Cu	0.5 - 10000 ppm	Pb	2 - 10000 ppm		
Fe	0.01 - 15%	S	0.01 - 5%		

*Note: The upper limit of 100ppm for Ag is achieved with the GE_ICP14B package only. GE_ICP12B will not fully recover Ag in high concentrations. Refer to the Ag specific methods on page 28.

TWO ACID / AQUA REGIA DIGESTION / ICP-MS PACKAGE (36 ELEMENTS)

GE IMS12B or GE IMS14B

ELEMENTS AND LIMIT(S)

Ag	0.01 - 10 ppm	Ga	0.1 - 10000 ppm	Sb	0.05 - 10000 ppm
Al	0.01 - 10%	Hg	0.01 - 100 ppm	Sc	0.1 - 10000 ppm
As	1 - 10000 ppm	K	0.01 - 10%	Sn	0.3 - 1000 ppm
Ba	5 - 10000 ppm	La	0.1 - 10000 ppm	Sr	0.5 - 10000 ppm
Bi	0.02 - 10000 ppm	Mg	0.01 - 15%	Th	0.1 - 10000 ppm
Ca	0.01 - 15%	Mn	2 - 10000 ppm	Ti	0.01 - 10%
Cd	0.01 - 10000 ppm	Mo	0.05 - 10000 ppm	Tl	0.02 - 10000 ppm
Ce	0.05 - 1000 ppm	Na	0.01 - 10%	U	0.05 - 10000 ppm
Co	0.1 - 10000 ppm	Ni	0.5 - 10000 ppm	V	1 - 10000 ppm
Cr	1 - 10000 ppm	P	0.01 - 1%	W	0.1 - 10000 ppm
Cu	0.5 - 10000 ppm	Pb	0.2 - 10000 ppm	Y	0.05 - 10000 ppm
Fe	0.01 - 15%	Rb	0.2 - 10000 ppm	Zn	1 - 10000 ppm

TWO ACID / AQUA REGIA DIGESTION / COMBINED ICP-AES AND ICP-MS PACKAGE (51 ELEMENTS)

GE ICM12B or GE ICM14B

ELEMENTS AND LIMIT(S)

Ag	0.01 - 100* ppm	Hg	0.01 - 10000 ppm	Sc	0.1 - 10000 ppm
Al	0.01 - 15%	In	0.02 - 500 ppm	Se	1 - 1000 ppm
As	1 - 10000 ppm	K	0.01 - 15%	Sn	0.3 - 1000 ppm
Ba	5 - 10000 ppm	La	0.1 - 10000 ppm	Sr	0.5 - 10000 ppm
Be	0.1 - 100 ppm	Li	1 - 10000 ppm	Ta	0.05 - 10000 ppm
Bi	0.02 - 10000 ppm	Lu	0.01 - 1000 ppm	Tb	0.02 - 10000 ppm
Ca	0.01 - 15%	Mg	0.01 - 15%	Te	0.05 - 1000 ppm
Cd	0.01 - 10000 ppm	Mn	2 - 10000 ppm	Th	0.1 - 10000 ppm

Ce	0.05 - 1000 ppm	Mo	0.05 - 10000 ppm	Ti	0.01 - 15%
Co	0.1 - 10000 ppm	Na	0.01 - 15%	Tl	0.02 - 10000 ppm
Cr	1 - 10000 ppm	Nb	0.05 - 1000 ppm	U	0.05 - 10000 ppm
Cs	0.05 - 1000 ppm	Ni	0.5 - 10000 ppm	V	1 - 10000 ppm
Cu	0.5 - 10000 ppm	P	0.01 - 15%	W	0.1 - 10000 ppm
Fe	0.01 - 15%	Pb	0.2 - 10000 ppm	Y	0.05 - 10000 ppm
Ga	0.1 - 10000 ppm	Rb	0.2 - 10000 ppm	Yb	0.1 - 100 ppm
Ge	0.1 - 10000 ppm	S	0.01 - 5%	Zn	1 - 10000 ppm
Hf	0.05 - 500 ppm	Sb	0.05 - 10000 ppm	Zr	0.5 - 10000 ppm

*Note: The upper limit of 100ppm for Ag is achieved with the GE_ICP14B package only. GE_ICP12B will not fully recover Ag in high concentrations. Refer to the Ag specific methods on page 28.

TWO ACID / AQUA REGIA DIGESTION / HYDRIDE AAS PACKAGE

GE HAS12B or GE HAS14B

ELEMENTS AND LIMIT(S)

As	0.1 - 500 ppm	Sb	0.1 - 500 ppm	Te	0.1 - 500 ppm
Bi	0.1 - 500 ppm	Se	0.1 - 500 ppm		

AQUA REGIA DIGESTION ICP-MS PACKAGE (49 ELEMENTS)

GE ARM133 (25g) or GE ARM155 (50g)

ELEMENTS AND LIMIT(S)

Ag	0.02 - 100 ppm	Hg	0.02 - 1000 ppm	Se	0.5 - 2500 ppm
As	0.5 - 2000 ppm	Ho	0.01 - 2000 ppm	Sm	0.02 - 1000 ppm
Au	1 - 500 ppb	In	0.005 - 2000 ppm	Sn	0.05 - 1000 ppm
Ba	0.5 - 5000 ppm	La	0.05 - 2000 ppm	Sr	0.1 - 1000 ppm
Be	0.02 - 1000 ppm	Li	0.1 - 2000 ppm	Ta	0.01 - 1000 ppm
Bi	0.01 - 2000 ppm	Lu	0.002 - 1000 ppm	Tb	0.005 - 1000 ppm
Cd	0.01 - 1000 ppm	Mn	0.5 - 5000 ppm	Te	0.02 - 1000 ppm
Ce	0.05 - 2000 ppm	Mo	0.02 - 2000 ppm	Th	0.01 - 1000 ppm
Co	0.1 - 1000 ppm	Nb	0.02 - 2000 ppm	Tl	0.01 - 1000 ppm
Cs	0.01 - 2000 ppm	Nd	0.025 - 2000 ppm	U	0.01 - 1000 ppm
Cu	0.5 - 5000 ppm	Ni	0.5 - 5000 ppm	W	1 - 1000 ppm
Dy	0.01 - 2000 ppm	Pb	0.2 - 1000 ppm	Y	0.02 - 1000 ppm

Er	0.01 - 2000 ppm	Pr	0.01 - 1000 ppm	Yb	0.01 - 1000 ppm
Eu	0.01 - 2000 ppm	Rb	0.05 - 1000 ppm	Zn	1 - 5000 ppm
Ga	0.05 - 1000 ppm	Re	0.001 - 100 ppm	Zr	0.1 - 2000 ppm
Gd	0.01 - 2000 ppm	Sb	0.02 - 1000 ppm		
Hf	0.01 - 2000 ppm	Sc	0.1 - 1000 ppm		

Very low detection limits can be obtained by aqua regia digest and ICP-MS finish. This technique is applicable to exploration work as it yields rapid and accurate data.

Note: GE ARM133 and GE ARM155 are not available in all SGS laboratories. Please inquire.

MULTI-ACID (FOUR ACID) DIGESTION PACKAGES

NITRIC, HYDROFLUORIC, PERCHLORIC AND HYDROCHLORIC ACID DIGEST

Multi-acid (Four acid) digestion is a very effective dissolution procedure for a large number of mineral species and is suitable for a wide range of elements. Multi-acid digestion uses a combination of HNO₃ (nitric acid), HF (hydrofluoric acid), HClO₄ (perchloric acid) and HCl (hydrochloric acid). Because hydrofluoric acid dissolves silicate minerals, these digestions are often referred to as "near-total digestions". For more details, see our publication, Rocks to Results, Chapter 4.

NOTE: Requires a minimum sample weight of 0.5g. Detection and upper limit can vary slightly among SGS laboratories because some laboratories may not have access to high purity reagents and consumables and/or they can have slight differences in instrumentation. Please talk with your local lab manager to make sure you get the reporting limits you need.

NOTE: Refractory minerals such as oxides have limited solubility in multi-acid (Four acid) digestions. Often elements can precipitate or volatilize during digestion. These factors can compromise analytical results for Al, Ba, Cr, Hf, Mo, Mn, Nb, Pb, Si, Sn, Ti, Ta, W, Zr, As, Sb, Se and Te in some sample types.

MULTI-ACID (FOUR ACID) DIGESTION / ICP-AES PACKAGE (33 ELEMENTS)

GE ICP40B

ELEMENTS AND LIMIT(S)

Ag	2 - 100 ppm	Fe	0.01 - 15%	S	0.01 - 5%
Al	0.01 - 15%	K	0.01 - 15%	Sb	5 - 10000 ppm
As	3 - 10000 ppm	La	0.5 - 10000 ppm	Sc	0.5 - 10000 ppm
Ba	1 - 10000 ppm	Li	1 - 10000 ppm	Sn	10 - 10000 ppm
Be	0.5 - 2500 ppm	Mg	0.01 - 15%	Sr	0.5 - 10000 ppm
Bi	5 - 10000 ppm	Mn	2 - 10000 ppm	Ti	0.01 - 15%
Ca	0.01 - 15%	Mo	1 - 10000 ppm	V	2 - 10000 ppm
Cd	1 - 10000 ppm	Na	0.01 - 15%	W	10 - 10000 ppm
Co	1 - 10000 ppm	Ni	1 - 10000 ppm	Y	0.5 - 10000 ppm
Cr	1 - 10000 ppm	P	0.01 - 15%	Zn	1 - 10000 ppm
Cu	0.5 - 10000 ppm	Pb	2 - 10000 ppm	Zr	0.5 - 10000 ppm

Note: Additional elements can be added. Please inquire.

MULTI-ACID (FOUR ACID) DIGESTION / COMBINED ICP-AES AND ICP-MS PACKAGE (49 ELEMENTS)

GE ICM40B

ELEMENTS AND LIMIT(S)

Ag	0.02 - 100 ppm	K	0.01 - 15%	Sn	0.3 - 1000 ppm
Al	0.01 - 15%	La	0.1 - 10000 ppm	Sr	0.5 - 10000 ppm
As	1 - 10000 ppm	Li	1 - 10000 ppm	Ta	0.05 - 10000 ppm
Ba	1 - 10000 ppm	Lu	0.01 - 1000 ppm	Tb	0.05 - 10000 ppm
Be	0.1 - 2500 ppm	Mg	0.01 - 15%	Te	0.05 - 1000 ppm
Bi	0.04 - 10000 ppm	Mn	2 - 10000 ppm	Th	0.2 - 10000 ppm
Ca	0.01 - 15%	Mo	0.05 - 10000 ppm	Ti	0.01 - 15%
Cd	0.02 - 10000 ppm	Na	0.01 - 15%	Tl	0.02 - 10000 ppm
Ce	0.05 - 1000 ppm	Nb	0.1 - 1000 ppm	U	0.05 - 10000 ppm
Cs	1 - 1000 ppm	Ni	0.5 - 10000 ppm	V	2 - 10000 ppm
Co	0.1 - 10000 ppm	P	0.001 - 15%	W	0.1 - 10000 ppm
Cr	1 - 10000 ppm	Pb	0.5 - 10000 ppm	Y	0.1 - 10000 ppm
Cu	0.5 - 10000 ppm	Rb	0.2 - 10000 ppm	Yb	0.1 - 1000 ppm
Fe	0.01 - 15%	S	0.01 - 5%	Zn	1 - 10000 ppm

Ga 0.1 - 500 ppm	Sb 0.05 - 10000 ppm	Zr 0.5 - 10000 ppm
Hf 0.02 - 500 ppm	Sc 0.5 - 10000 ppm	
In 0.02 - 500 ppm	Se 2 - 1000 ppm	

Note: Select packages for rare earth elements can be found on pg 59.

FUSION PACKAGES

Fusion involves the complete digestion of the sample in molten flux. Fusions are generally more aggressive than acid digestion methods and are suitable for many refractory, difficult-to-dissolve minerals such as chromite, ilmenite, spinel, cassiterite and minerals of the tantalum-tungsten solid solution series. Fusion analyses are presumed to provide a complete chemical analysis and are referred to as a "total" analysis.

For more details, see our publication, Rocks to Results, Chapter 4.

NOTE: Detection and upper limit can vary slightly among SGS laboratories because some laboratories may not have access to high purity reagents and consumables and/or they can have slight differences in instrumentation. Please talk with your local lab manager to make sure you get the reporting limits you need.

SODIUM PEROXIDE FUSION

Sodium peroxide is a strongly oxidizing flux that is basic, not acidic in nature. It renders most refractory minerals soluble. Because the fusion temperature is lower than that of lithium metaborate fusions, the hydride elements are not volatilized. This technique requires a minimum sample weight of 0.2 g.

SODIUM PEROXIDE FUSION / ICP-AES PACKAGE (29 ELEMENTS)

GE ICP90A

ELEMENTS AND LIMIT(S)

Al 0.01 - 25%	K 0.1 - 25%	Sc 0.0005 - 5%
As 0.003 - 10%	La 0.001 - 5%	Si 0.1 - 30%
Ba 0.001 - 5%	Li 0.001 - 5%	Sn 0.005 - 5%
Be 0.0005 - 2.5%	Mg 0.01 - 25%	Sr 0.001 - 0.5%

Ca 0.1 - 25%	Mn 0.001 - 10%	Ti 0.01 - 25%
Cd 0.001 - 5%	Mo 0.001 - 5%	V 0.001 - 5%
Co 0.001 - 5%	Ni 0.001 - 10%	W 0.005 - 4%
Cr 0.001 - 5%	P 0.01 - 25%	Y 0.0005 - 2.5%
Cu 0.001 - 5%	Pb 0.002 - 10%	Zn 0.001 - 5%
Fe 0.01 - 25%	Sb 0.005 - 10%	

SODIUM PEROXIDE FUSION / COMBINED ICP-AES AND ICP-MS PACKAGE (56 ELEMENTS)

GE ICM90A

ELEMENTS AND LIMIT(S)

Ag 1 - 200 ppm	Ge 1 - 1000 ppm	Sb 0.1 - 10000 ppm
Al 0.01 - 25%	Hf 1 - 10000 ppm	Si 0.1 - 30%
As 0.0005 - 10%	Ho 0.05 - 1000 ppm	Sm 0.1 - 1000 ppm
Ba 10 - 10000 ppm	In 0.2 - 1000 ppm	Sn 1 - 10000 ppm
Be 5 - 2500 ppm	K 0.1 - 25%	Sr 10 - 5000 ppm
Bi 0.1 - 1000 ppm	La 0.1 - 10000 ppm	Ta 0.5 - 10000 ppm
Ca 0.1 - 25%	Li 0.001 - 5%	Tb 0.05 - 1000 ppm
Cd 0.2 - 10000 ppm	Lu 0.05 - 1000 ppm	Th 0.1 - 1000 ppm
Ce 0.1 - 10000 ppm	Mg 0.01 - 25%	Ti 0.01 - 25%
Co 0.5 - 10000 ppm	Mn 0.001 - 10%	Tl 0.5 - 1000 ppm
Cr 0.001 - 5%	Mo 2 - 10000 ppm	Tm 0.05 - 1000 ppm
Cs 0.1 - 10000 ppm	Nb 1 - 10000 ppm	U 0.05 - 1000 ppm
Cu 10 - 10000 ppm	Nd 0.1 - 10000 ppm	V 5 - 10000 ppm
Dy 0.05 - 1000 ppm	Ni 5 - 10000 ppm	W 1 - 10000 ppm
Er 0.05 - 1000 ppm	P 0.01 - 25%	Y 0.5 - 1000 ppm
Eu 0.05 - 1000 ppm	Pb 5 - 10000 ppm	Yb 0.1 - 1000 ppm
Fe 0.01 - 25%	Pr 0.05 - 1000 ppm	Zn 5 - 10000 ppm
Ga 1 - 1000 ppm	Rb 0.2 - 10000 ppm	Zr 0.5 - 10000 ppm
Gd 0.05 - 1000 ppm	Sc 0.0005 - 5%	

SGS now offers an innovative, low cost, multi-element, analytical fusion package (GE_IMS90A). This package offers the best recoveries, fastest analysis time with the widest range of limits and elements offered in a single pass.

SODIUM PEROXIDE FUSION / ICP-MS PACKAGE (34 ELEMENTS)

GE IMS90A

ELEMENTS AND LIMIT(S)

Ag	1 - 200 ppm	Fe	0.01 - 25%	Si	0.1 - 40%
Al	0.01 - 25%	K	0.1 - 30%	Sn	1 - 10000 ppm
As	3 - 10000 ppm	La	0.1 - 10000 ppm	Sr	10 - 10000 ppm
Ba	10 - 10000 ppm	Li	5 - 10000 ppm	Te	1 - 1000 ppm
Be	1 - 2500 ppm	Mg	0.01 - 30%	Ti	0.01 - 30%
Bi	0.1 - 1000 ppm	Mn	10 - 10000 ppm	V	5 - 10000 ppm
Ca	0.1 - 25%	Mo	2 - 10000 ppm	W	5 - 10000 ppm
Cd	0.2 - 10000 ppm	Ni	5 - 50000 ppm	Y	0.5 - 10000 ppm
Co	0.5 - 10000 ppm	P	0.01 - 25%	Yb	0.1 - 1000 ppm
Cr	5 - 10000 ppm	Pb	2 - 50000 ppm	Zn	5 - 50000 ppm
Cs	0.1 - 10000 ppm	S	1 - 25%		
Cu	2 - 50000 ppm	Sb	1 - 10000 ppm		

Note: This package is currently only available at our Burnaby, Canada location. An additional 22 elements (Ce, Dy, Er, Eu, Ga, Gd, Ge, Ho, In, Lu, Nb, Nd, Pr, Rb, Re, Sm, Ta, Tb, Th, Tl, Tm, U) can be added. Please inquire.

SODIUM PEROXIDE FUSION / HYDRIDE AAS PACKAGE

GE HAS90A

ELEMENTS AND LIMIT(S)

As	0.5 - 1000 ppm	Bi	0.5 - 1000 ppm	Sb	0.5 - 1000 ppm
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LITHIUM METABORATE FUSION

Lithium metaborate fusion is a high temperature procedure that dissolves rock forming minerals, trace minerals and refractory minerals. Lithium metaborate fusion solutions can be analyzed by ICP-AES, ICP-MS or both ICP-AES and ICP-MS. This technique requires a minimum sample weight of 0.2 g.

LITHIUM METABORATE FUSION / ICP-MS PACKAGE (33 ELEMENTS)

GE IMS95A

ELEMENTS AND LIMIT(S)

Ag	1 - 200 ppm	Ho	0.05 - 1000 ppm	Ta	0.5 - 10000 ppm
Ce	0.1 - 10000 ppm	La	0.1 - 10000 ppm	Tb	0.05 - 1000 ppm
Co	0.5 - 10000 ppm	Lu	0.05 - 1000 ppm	Th	0.1 - 1000 ppm
Cs	0.1 - 10000 ppm	Mo	2 - 10000 ppm	Tl	0.5 - 1000 ppm
Cu	5 - 10000 ppm	Nb	1 - 10000 ppm	Tm	0.05 - 1000 ppm
Dy	0.05 - 1000 ppm	Nd	0.1 - 10000 ppm	U	0.05 - 10000 ppm
Er	0.05 - 1000 ppm	Ni	5 - 10000 ppm	V	5 - 10000 ppm
Eu	0.05 - 1000 ppm	Pr	0.05 - 1000 ppm	W	1 - 10000 ppm
Ga	1 - 1000 ppm	Rb	0.2 - 10000 ppm	Y	0.5 - 1000 ppm
Gd	0.05 - 1000 ppm	Sm	0.1 - 1000 ppm	Yb	0.1 - 1000 ppm
Hf	1 - 10000 ppm	Sn	1 - 10000 ppm	Zr	0.5 - 1000 ppm

XRF ANALYSIS

X-ray fluorescence (XRF) spectroscopy has been available to the geochemical industry for over 50 years. It is the preferred method for the determination of the major oxides as well as some trace elements. The advantages of XRF include its:

- Accurate analyses, arising from the fact that inter-element corrections are well known and highly predictable.
- Precise determinations, due to inherent instrumental factors.
- Rapid analysis time.
- Ability to use a solid sample as opposed to a liquid digest.
- Wide analytical range which extends from the parts-per-million to tens of percent range.

Fusion and pressed pellet are the two industry-standard sample preparation techniques for XRF analysis. In pressed pellet XRF, samples are compressed into a pellet and analyzed instrumentally. Only lower levels of metals can be done accurately by this method. Fusion involves melting the sample with flux

and casting it into a glass disc. Trace element and sulphide samples require specialized fusions or the pressed pellet technique. Please talk to us to determine the right method for your samples.

For information about fusion-XRF packages for whole rock samples, base metals, iron ores, REEs, and other minerals, please refer to the Ore-Grade Analysis section in this guide.

PRESSED PELLET / XRF PACKAGE (26 ELEMENTS)

GE XRF75V

ELEMENTS AND LIMIT(S)

As	3 - 10000 ppm	Mn	50 - 10000 ppm	Th	5 - 10000 ppm
Ba	10 - 4000 ppm	Mo	3 - 10000 ppm	Ti	4 - 10000 ppm
Ca	0.01 - 20%	Nb	2 - 4000 ppm	U	5 - 4000 ppm
Co	2 - 4000 ppm	Ni	2 - 4000 ppm	V	5 - 10000 ppm
Cr	5 - 4000 ppm	Pb	5 - 10000 ppm	W	5 - 4000 ppm
Cu	2 - 4000 ppm	Rb	2 - 4000 ppm	Y	2 - 4000 ppm
Ga	3 - 4000 ppm	Sb	3 - 4000 ppm	Zn	2 - 4000 ppm
Ge	5 - 10000 ppm	Sn	3 - 4000 ppm	Zr	3 - 4000 ppm
K	0.01 - 20%	Sr	2 - 4000 ppm		

Note: This method is not available at all SGS laboratories, please inquire. This technique requires a minimum sample weight of 12g.

MOBILE METAL ION – MMI™

SGS is the owner and sole provider of MMI™ Technology. We have over 15 years of experience with this technology, and we are the market leaders in providing a weak extraction of the mobile form of the ions residing in near surface soils. MMI™ is a world-renowned exploration tool repeatedly proven to find buried mineral deposits.

MMI™ Technology is an innovative analytical process that uses a unique approach to the semi-quantitative analysis of metals in soils and weathered materials. Target elements are extracted using weak solutions of organic and inorganic compounds rather than conventional aggressive acid or cyanide-based digests. MMI™ solutions contain strong ligands, which detach and hold the metal ions that were loosely bound to soil particles by

weak atomic forces. The extraction does not dissolve the bound forms of the metal ions. Thus, the metal ions in MMI solutions are the chemically active or 'mobile' component of the sample. Because these mobile, loosely bound complexes are in very low concentrations, elemental determinations are made by conventional ICP-MS and the latest evolution of this technology, ICP-MS Dynamic Reaction Cell™ (DRC II™).

There are many benefits to using MMI™ Technology for soil geochemistry.

- Few false anomalies
- Focused anomalies
- Minimal nugget effects

SAMPLE COLLECTION

Sample collection is the most critical part of a soil geochemistry program. The MMI™ Technology has specific sampling protocol based on years of experience and research. In the absence of an orientation survey, samples must be taken at a constant depth (10-25 cm) below the organic-inorganic soil interface. There is no sample preparation or drying. The analysis is done on a 50 gram sample and the extracted solution is analyzed via ICP-MS or ICP-MS DRCII™, providing determinations in the part per billion range. For detailed instructions for the MMI™ sampling protocols and orientation surveys, please visit www.sgs.com/mining/mmi or contact us at minerals@sgs.com.

ICP-MS DRC II™

SGS is committed to the MMI™ Technology. With the development of the ICP-MS DRC II™, we have been able to further enhance this analytical approach. The lower detection limits provided by ICP-MS DRC II™ mean that we can better define anomalous targets. For instance, for the exploration of nickel deposits, kimberlites and layered intrusions, low level chrome (1 ppb) is an important geological trace element. For uranium exploration, low level vanadium (1 ppb) is also important. If either or both of these elements are required for your program, we can analyze your samples for low chrome and/or vanadium values using our MMI-ME package.

Sulfur, bromine, iodine and lead isotopes can be added to the MMI packages. For these additional elements, please contact us at minerals@sgs.com.

MOBILE METAL ION STANDARD PACKAGE / ICP-MS (53 ELEMENTS)

GE MMI-M

ELEMENTS AND LIMIT(S)

Ag	0.5 ppb	Er	0.2 ppb	Nd	1 ppb	Tb	0.1 ppb
Al	1 ppm	Eu	0.2 ppb	Ni	5 ppb	Te	10 ppb
As	10 ppb	Fe	1 ppm	P	0.1 ppm	Th	0.5 ppb
Au	0.1 ppb	Ga	0.5 ppb	Pb	5 ppb	Ti	10 ppb
Ba	10 ppb	Gd	0.5 ppb	Pd	1 ppb	Tl	0.1 ppb
Bi	0.5 ppb	Hg	1 ppb	Pr	0.5 ppb	U	0.5 ppb
Ca	2 ppm	In	0.1 ppb	Pt	0.1 ppb	W	0.5 ppb
Cd	1 ppb	K	0.5 ppm	Rb	1 ppb	Y	1 ppb
Ce	2 ppb	La	1 ppb	Sb	0.5 ppb	Yb	0.2 ppb
Co	1 ppb	Li	1 ppb	Sc	5 ppb	Zn	10 ppb
Cr	100 ppb	Mg	0.5 ppm	Sm	1 ppb	Zr	2 ppb
Cs	0.2 ppb	Mn	100 ppb	Sn	1 ppb		
Cu	10 ppb	Mo	2 ppb	Sr	10 ppb		
Dy	0.5 ppb	Nb	0.5 ppb	Ta	1 ppb		

MOBILE METAL ION ENHANCED PACKAGE / ICP-MS (55 ELEMENTS)

GE MMI-ME

ELEMENTS AND LIMIT(S)

Ag	0.5 ppb	Er	0.2 ppb	Nd	1 ppb	Ta	1 ppb
Al	1 ppm	Eu	0.2 ppb	Ni	5 ppb	Tb	0.1 ppb
As	10 ppb	Fe	1 ppm	P	0.1 ppm	Te	10 ppb
Au	0.1 ppb	Ga	0.5 ppb	Pb	5 ppb	Th	0.5 ppb
Ba	10 ppb	Gd	0.5 ppb	Pd	1 ppb	Ti	10 ppb
Bi	0.5 ppb	Hg	1 ppb	Pr	0.5 ppb	Tl	0.1 ppb
Ca	2 ppm	In	0.1 ppb	Pt	0.1 ppb	U	0.5 ppb
Cd	1 ppb	K	0.5 ppm	Rb	1 ppb	V	1 ppb
Ce	2 ppb	La	1 ppb	Sb	0.5 ppb	W	0.5 ppb
Co	1 ppb	Li	1 ppb	Sc	5 ppb	Y	1 ppb
Cr	1 ppb	Mg	0.5 ppm	Se	2 ppb	Yb	0.2 ppb

Cs	0.2 ppb	Mn	100 ppb	Sm	1 ppb	Zn	10 ppb
Cu	10 ppb	Mo	2 ppb	Sn	1 ppb	Zr	2 ppb
Dy	0.5 ppb	Nb	0.5 ppb	Sr	10 ppb		

Note: Sulfur, bromine, iodine and lead isotopes can be added to the MMI-ME package by special request.

MOBILE METAL ION PRECIOUS METAL PLUS PACKAGE / ICP-MS (11 ELEMENTS)

GE MMI-MP

ELEMENTS AND LIMIT(S)

Au	0.05 ppb	Ag	0.1 ppb	Cu	10 ppb	Zn	10 ppb
Pd	0.1 ppb	Cd	0.5 ppb	Ni	5 ppb	U	0.5 ppb
Pt	0.02 ppb	Co	1 ppb	Pb	5 ppb		

BIOGEOCHEMISTRY

SGS has considerable experience in the preparation and analysis of a wide range of vegetation samples. Such samples may be dried and macerated or ashed prior to acid digestion and analysis by ICP-MS. Please consult your local lab for more information on elements and limits.

GE ICM11D

HYDROGEOCHEMISTRY

The analyses offered in this section are suitable for groundwater samples used in mineral exploration, but NOT for salt water, brines, effluent solutions and metal-carrying solutions generated in processing circuits or environmental applications. Samples such as salt water, effluents or metal-carrying solutions will incur an extra charge and element detection limits can increase. Requests for environmental services will be forwarded to an SGS Environmental Services Laboratory.

GROUND WATER ANALYSIS / ICP-AES PACKAGE (31 ELEMENTS)

GE ICP80T

ELEMENTS AND LIMIT(S)

Ag	1 ppb	Co	10 ppb	Mo	10 ppb	Sr	1 ppb
Al	50 ppb	Cr	10 ppb	Na	50 ppb	Ti	10 ppb
As	30 ppb	Cu	5 ppb	Ni	10 ppb	V	10 ppb
Ba	10 ppb	Fe	50 ppb	P	50 ppb	W	50 ppb
Be	5 ppb	K	100 ppb	Pb	30 ppb	Y	5 ppb
Bi	50 ppb	La	10 ppb	Sb	50 ppb	Zn	5 ppb
Ca	50 ppb	Mg	50 ppb	Sc	1 ppb	Zr	10 ppb
Cd	10 ppb	Mn	5 ppb	Sn	50 ppb		

GROUND WATER ANALYSIS / ICP-MS PACKAGE (49 ELEMENTS)

GE IMS80T

ELEMENTS AND LIMIT(S)

Ag	0.01 ppb	Eu	0.01 ppb	Ni	0.1 ppb	Th	0.01 ppb
As	1 ppb	Ga	0.01 ppb	Pb	0.01 ppb	Tl	0.01 ppb
Ba	0.01 ppb	Gd	0.01 ppb	Pr	0.01 ppb	Tm	0.01 ppb
Be	0.1 ppb	Hf	0.01 ppb	Rb	0.1 ppb	U	0.01 ppb
Bi	0.01 ppb	Hg	0.2 ppb	Sb	0.1 ppb	V	1 ppb
Cd	0.01 ppb	Ho	0.01 ppb	Sc	0.1 ppb	W	0.01 ppb
Ce	0.01 ppb	In	0.01 ppb	Se	1 ppb	Y	0.01 ppb
Cs	0.01 ppb	La	0.01 ppb	Sm	0.01 ppb	Yb	0.01 ppb
Cr	1 ppb	Lu	0.05 ppb	Sn	0.01 ppb	Zn	1 ppb
Co	0.1 ppb	Mn	0.1 ppb	Sr	0.01 ppb	Zr	0.1 ppb
Cu	0.1 ppb	Mo	1 ppb	Ta	0.01 ppb		
Dy	0.1 ppb	Nb	0.01 ppb	Tb	0.01 ppb		
Er	0.01 ppb	Nd	0.01 ppb	Te	0.1 ppb		

Note: Au, Pt, Pd, Rh, Ru, Ir and Re can be added upon request.

ADDITIONAL GROUND WATER ANALYSIS

CODE(S)	ELEMENT	DESCRIPTION
GE PHY22V	Total dissolved solids (TDS)	Gravimetric
GE ISE06T	pH	Ion selective electrode (ISE)
GE ISE07T	Fluoride F ⁻	Ion selective electrode (ISE)
GE ISE08T	Chloride Cl ⁻	Ion selective electrode (ISE)

INDIVIDUAL METHODS FOR EXPLORATION-GRADE ANALYSIS

SULPHUR AND CARBON

CODE(S)	ELEMENT	LIMIT(S)	DESCRIPTION	MIN. SAMPLE WT.(g)
GE CSA06V	S	0.005 - 30%	IR Combustion	0.2
	C	0.005 - 30%		0.2
GE CSA07V	SO ₄ ²⁻	0.01%	Leach/ IR combustion	1.0
GE CSA08V	S ²⁻	0.01%	Leach/Digest/ IR combustion	2.0
GE CSA09V	S (elemental)	0.01%	Leach/Gravimetry	1.0
GE CSA02V	CO ₂ (Carbonate)	0.05%	IR combustion	1.0
GE CSB02V	CO ₂ (Carbonate)	0.05%	Coulometry	1.0
GE CSA03V	C (organic, inorganic)	0.01%	IR combustion	1.0
GE CSB03V	C (organic, inorganic)	0.05%	Coulometry	1.0
GE CSA05V	C (graphitic)	0.05%	IR combustion	1.0
GE CSB05V	C (graphitic)	0.05%	Coulometry	1.0

ADDITIONAL SINGLE ELEMENTS

CODE(S)	ELEMENT	LIMIT(S)	DESCRIPTION	MIN. SAMPLE WT.(g)
GE CVA20A	Hg	0.005 - 100 ppm	Cold vapour AAS	0.2
GE ISE07A	F	0.0025 - 10%	Ion selective electrode	0.2
GE ISE08B	Cl	50 - 5000 ppm	Ion selective electrode	0.5
GE CLA02V	Cl	0.005 - 1%	Titration	0.5
GE ISE15V	pH (soils/sediments)		Ion selective electrode (ISE)	

SGS offers a wide variety of specific element analyses. Please contact your local site.

ORE-GRADE ANALYSIS

Ore-grade packages are used to analyse samples that have high concentrations of pay metals. They can be used in prefeasibility, feasibility or production circumstances. As well, these methods can be used to provide over range analysis when an upper limit of an element in an exploration package is exceeded. Typically, ore-grade analyses are accomplished by adjusting the sample weight and final solution volume ratio, thus expanding the linear range of the analysis. Refer to GO ICP13B and GO ICP41Q below. Additional elements are available, please inquire.

OVER RANGE PACKAGES

AQUA REGIA DIGESTION / ICP-AES PACKAGE (12 ELEMENTS)

GO ICP13B

ELEMENTS AND LIMIT(S)

Ag 0.01 - 0.1%	Cu 0.01 - 30%	Ni 0.001 - 10%
As 0.01 - 10%	Fe 0.01 - 30%	Pb 0.001 - 10%
Cd 0.001 - 10%	Mn 0.01 - 10%	S 0.01 - 30%
Co 0.001 - 10%	Mo 0.001 - 10%	Zn 0.01 - 10%

MULTI-ACID (FOUR ACID) DIGESTION / ICP-AES PACKAGE (33 ELEMENTS)

GO ICP41Q

ELEMENTS AND LIMIT(S)

Ag 0.01 - 0.1%	Fe 0.01 - 30%	Ni 0.001 - 10%
As 0.01 - 10%	Li 0.01 - 10%	Pb 0.01 - 30%
Cd 0.001 - 10%	Mn 0.001 - 10%	S 0.01 - 10%
Co 0.001 - 10%	Mo 0.001 - 10%	Zn 0.01 - 30%
Cu 0.01 - 30%		

Note: Additional elements can be added to either package upon request. For a total digest over range package, refer to our fusion package, GO ICP90Q on page 50.

MULTI-ACID (FOUR ACID) DIGESTION PACKAGES

FOUR ACID DIGESTION / AAS PACKAGE (16 ELEMENTS)

GO AAS42S

ELEMENTS AND LIMIT(S)

Ag 5 - 500 ppm	Cr 0.005 - 5%	Pb 0.002 - 2.5%
As 0.025 - 5%	Cu 0.001 - 50%	Sb 0.01 - 2%
Bi 50 - 5000 ppm	Fe 0.01 - 40%	V 0.005 - 5%
Ca 0.01 - 40%	Mn 0.001 - 5%	Zn 0.001 - 5%
Cd 5 - 5000 ppm	Mo 0.002 - 5%	
Co 0.002 - 2.5%	Ni 0.001 - 5%	

FOUR ACID DIGESTION / ICP-AES PACKAGE (26 ELEMENTS)

GO ICP42S

ELEMENTS AND LIMIT(S)

Ag 5 - 250 ppm	Fe 0.025 - 100%	Pb 0.0025 - 2.5%
Al 0.025 - 40%	K 0.1 - 40%	Sb 0.001 - 2%
As 0.002 - 2.5%	Li 5 - 2500 ppm	Sn 0.002 - 2%
Bi 0.005 - 2.5%	Mg 0.005 - 40%	Ta 0.005 - 2.5%

Ca	0.01 - 40%	Mn	0.002 - 2.5%	Ti	0.002 - 5%
Cd	0.0005 - 2%	Mo	0.002 - 2.5%	V	0.0005 - 2.5%
Co	0.001 - 2.5%	Na	0.01 - 40%	Zn	0.001 - 5%
Cr	0.002 - 5%	Ni	0.002 - 2.5%	Zr	0.001 - 5%
Cu	0.001 - 2.5%	P	0.01 - 25%		

Note: Requires a minimum sample weight of 0.5 g.

FUSION-ICP PACKAGES

SODIUM PEROXIDE FUSION / ICP-AES PACKAGE

GO ICP90Q

ELEMENTS AND LIMIT(S)

Co	0.01 - 30%	Mo	0.01 - 30%	Pb	0.01 - 30%
Cu	0.01 - 30%	Ni	0.01 - 30%	Zn	0.01 - 30%
Fe	0.05 - 50%				

Additional elements can be added to this method upon request (e.g., As, Bi, Cd, Mg, Mn) Elements greater than 30% can require analysis by another technique for full recovery. Requires a minimum sample weight of 0.5 g.

SODIUM PEROXIDE FUSION / ICP-AES NICKEL LATERITE PACKAGE (SAMPLES DRIED AT 105°C / 8 HOURS)

GO ICP90B

ELEMENTS AND LIMIT(S)

Al ₂ O ₃	0.01 - 25%	Cu	0.01 - 10%	Ni	0.01 - 10%
CaO	0.1 - 35%	Fe ₂ O ₃	0.01 - 30%	P ₂ O ₅	0.01 - 25%
Cr	0.01 - 10%	K ₂ O	0.1 - 25%	SiO ₂	0.01 - 25%
Co	0.01 - 10%	MgO	0.01 - 30%	TiO ₂	0.01 - 25%

Requires a minimum sample weight of 0.5 g.

LITHIUM METABORATE FUSION / ICP-AES (LITHOLOGIC) PACKAGE (18 ELEMENTS)

GO ICP95A

ELEMENTS AND LIMIT(S)

Al ₂ O ₃	0.01 - 75%	MgO	0.01 - 30%	Sr	0.001 - 10%
Ba	0.001 - 10%	MnO	0.01 - 10%	TiO ₂	0.01 - 25%
CaO	0.01 - 60%	Na ₂ O	0.01 - 30%	Y	0.001 - 10%
Cr ₂ O ₃	0.01 - 10%	Nb	0.001 - 10%	Zn	5 - 10000 ppm
Fe ₂ O ₃	0.01 - 75%	P ₂ O ₅	0.01 - 25%	Zr	0.001 - 10%
K ₂ O	0.01 - 25%	SiO ₂	0.01 - 90%	LOI	-10 - 100%

Requires a minimum sample weight of 0.5g.

FUSION-XRF PACKAGES

Whole rock analysis is the determination of major elements (reported as "oxides"). This analysis will approximate 100% in non-mineralized samples. SGS offers whole rock analysis using both ICP-AES or XRF below.

Whole rock analysis by XRF is particularly suitable for the analysis of bulk commodities such as iron ore, silicate, feldspar, gypsum and limestone.

This method is not suitable for samples with a sulphide mineral content > 1%.

BORATE FUSION / XRF WHOLE ROCK PACKAGE (13 ELEMENTS)

GO XRF76V

ELEMENTS AND LIMIT(S)

Al ₂ O ₃	0.01 - 100%	MnO	0.01 - 100%	TiO ₂	0.01 - 100%
CaO	0.01 - 100%	Na ₂ O	0.01 - 100%	V ₂ O ₅	0.01 - 100%
Cr ₂ O ₃	0.01 - 100%	P ₂ O ₅	0.01 - 100%	LOI	-10 - 100%
K ₂ O	0.01 - 100%	Fe ₂ O ₃	0.01 - 100%	SUM	%
MgO	0.01 - 100%	SiO ₂	0.01 - 100%		

Additional major and minor elements can be added to the borate fusion / XRF method. Requires a minimum sample weight of 5.0 g. Please contact your local lab. Rare earth elements can also be analyzed by this technique. Refer to page 61. For iron ore samples (GO XRF78S), refer to page 65.

PYROSULPHATE FUSION / XRF BASE METAL PACKAGE (10 ELEMENTS)

GO XRF77B

ELEMENTS AND LIMIT(S)

Co	0.01 - 100%	Mn	0.01 - 100%	W	0.01 - 100%
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Cr	0.01 - 100%	Mo	0.01 - 100%	Zn	0.01 - 100%
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Cu	0.01 - 100%	Ni	0.01 - 100%
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Fe	0.01 - 100%	Pb	0.01 - 100%
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Note: Requires a minimum sample weight of 1.0 g.

INDIVIDUAL METHODS FOR ORE-GRADE ANALYSIS

INTERNAL STANDARD / RESISTIVE MINERALS / XRF

GO XRF75F

ELEMENTS AND LIMIT(S)

As	≥0.001%	Sn	≥0.002%	ThO ₂	≥0.005%	WO ₃	≥0.002%
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Sb	≥0.002%	Ta	≥0.002%	U ₃ O ₈	≥0.002%
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Note: Requires a minimum sample weight of 25 g, depending on the elements of interest. This method is not available at all SGS laboratories. Please inquire.

SULPHUR AND CARBON

CODE	ELEMENT	LIMIT(S)	DESCRIPTION
GO CSA06V	S	0.01 - 75%	IR combustion
	C	0.01 - 75%	

Note: Requires a minimum sample weight of 0.2 g. Carbon and sulphur can be speciated using a variety of methods. Please inquire.

ADDITIONAL SINGLE ELEMENTS

CODE(S)	ELEMENT	LIMIT(S)	DESCRIPTION	MIN. SAMPLE WT.(g)
GO CVA20B	Hg	0.3ppm - 100%	Cold vapour AAS	0.4
GO CLA10E	Insolubles (acid)	0.1%	Gravimetric	5
GO CLA07C	CaO	0.01%	Available lime	2
GO CLA01V	FeO	0.1 - 30%	Ferric/Ferrous iron titration	0.5

SGS can analyse a number of individual ore-grade elements. Please inquire.

CONTROL-GRADE ANALYSIS

Metallurgical processes are monitored and controlled by the chemical analysis of feed and head samples, middlings, concentrates, metals, tails, slags, residues or pregnant solutions. A wide range of analytical techniques are needed to accommodate the varying matrices and complex nature of such samples. Several of the techniques are listed here, but this list is not meant to be comprehensive. We have extensive experience supporting metallurgical facilities and would be happy to speak with you regarding your specific project requirements.

CUSTOMIZED SPECTROSCOPIC ANALYSIS

The analytical approach for control analysis differs from the standard geochemistry “package” methodology. Instead, we provide both multi-element packages and customized spectroscopic determinations that can include multiple dilutions and spectral analyses on an element-by-element basis to ensure that the interferences common in complex samples are identified and resolved.

These control assay methods are only a small selection of the methods and capabilities available at SGS. A wide variety of other methods are available including fire assay, manual and automated titrations, CVAA mercury analysis, AAS, carbon, sulphur and chromatography. Fire assay methods often require customized fluxes and finishes. Please contact us if you have any needs in this area – we have lots of expertise to share.

TWO ACID/AQUA REGIA DIGESTION PACKAGES

AQUA REGIA DIGESTION PACKAGE / ICP-AES (30 ELEMENTS)

GC ICP14C

ELEMENTS AND REPORTING LIMIT(S)

Ag 0.8 ppm	Co 3 ppm	Mo 6 ppm	Sr 0.02 ppm
Al 2 ppm	Cr 1 ppm	Na 20 ppm	Ti 0.2 ppm
As 30 ppm	Cu 1 ppm	Ni 6 ppm	Tl 30 ppm
Ba 0.07 ppm	Fe 2 ppm	P 50 ppm	V 2 ppm
Be 0.02 ppm	K 10 ppm	Pb 20 ppm	Y 0.2 ppm
Bi 10 ppm	Li 20 ppm	Sb 10 ppm	Zn 7 ppm
Ca 9 ppm	Mg 0.7 ppm	Se 30 ppm	
Cd 0.9 ppm	Mn 0.4 ppm	Sn 20 ppm	

Additional elements can be added. An ICP-MS option is available. Concentrate samples containing greater than 50% of the target element can require alternative analytical methods if full recovery is required. Requires a minimum sample weight of 1.0 g.

MULTI-ACID (FOUR ACID) DIGESTION PACKAGES

MULTI-ACID DIGESTION PACKAGE / ICP-AES (30 ELEMENTS)

GC ICP42C

ELEMENTS AND REPORTING LIMIT(S)

Ag 2 ppm	Co 4 ppm	Mo 5 ppm	Sr 0.03 ppm
Al* 2 ppm	Cr* 4 ppm	Na 10 ppm	Ti* 0.4 ppm
As* 30 ppm	Cu 0.5 ppm	Ni 20 ppm	Tl 30 ppm
Ba* 0.2 ppm	Fe 4 ppm	P 30 ppm	V 2 ppm
Be 0.03 ppm	K* 20 ppm	Pb 20 ppm	Y 0.2 ppm
Bi 20 ppm	Li 5 ppm	Sb* 10 ppm	Zn 2 ppm
Ca* 20 ppm	Mg* 1 ppm	Se 30 ppm	
Cd 2 ppm	Mn 0.3 ppm	Sn* 20 ppm	

Additional elements can be added. An ICP-MS option is available. Requires a minimum sample weight of 1.0 g. Concentrate samples containing greater than 50% of the target element can require alternative analytical methods if full recovery is required.

*Recovery can be incomplete so analysis can be biased low.

MULTI-ACID DIGESTION PACKAGE / FUSION / ICP-AES (30 ELEMENTS)

GC ICP46C

ELEMENTS AND REPORTING LIMIT(S)

Ag 2 ppm	Co 4 ppm	Mo 5 ppm	Sr 0.03 ppm
Al 2 ppm	Cr 4 ppm	Na 10 ppm	Ti 0.4 ppm
As 30 ppm	Cu 0.5 ppm	Ni 20 ppm	Tl 30 ppm
Ba 0.2 ppm	Fe 4 ppm	P 30 ppm	V 2 ppm
Be 0.03 ppm	K 20 ppm	Pb 20 ppm	Y 0.2 ppm
Bi 20 ppm	Li 5 ppm	Sb 10 ppm	Zn 2 ppm
Ca 20 ppm	Mg 1 ppm	Se 30 ppm	
Cd 2 ppm	Mn 0.3 ppm	Sn 20 ppm	

Additional elements can be added. An ICP-MS option is available. Requires a minimum sample weight of 1.0 g. Concentrate samples containing greater than 50% of the target element can require alternative analytical methods if full recovery is re-quired. Data for volatiles (e.g., As, Sb) may be incomplete.

FUSION PACKAGES

FUSION / ICP-AES PACKAGE (28 ELEMENTS)

GC ICP93A

ELEMENTS AND REPORTING LIMIT(S)

Ag	200 ppm	Co	200 ppm	Mo	300 ppm	Tl	2000 ppm
Al	400 ppm	Cr	40 ppm	Ni	300 ppm	V	80 ppm
As	1200 ppm	Cu	40 ppm	Pb	800 ppm	Y	8 ppm
Ba	3 ppm	Fe	500 ppm	Sb	400 ppm	Zn	300 ppm
Be	0.8 ppm	K	400 ppm	Se	2000 ppm		
Bi	400 ppm	Li	800 ppm	Sn	800 ppm		
Ca	800 ppm	Mg	30 ppm	Sr	10 ppm		
Cd	40 ppm	Mn	20 ppm	Ti	8 ppm		

Additional elements can be added. An ICP-MS option is available. Requires a minimum sample weight of 0.2 g. Concentrate samples containing greater than 50% of the target element can require alternative analytical methods if full recovery is required.

FUSION / AAS PACKAGE (11 ELEMENTS)

GC AAS93A

ELEMENTS AND REPORTING LIMIT(S)

Al	0.02 %	Fe	0.01 %	Si	0.07 %	V	0.1 %
Ca	0.06 %	Mg	0.005 %	Sn	0.05 %	Zn	0.001 %
Cr	0.005 %	Mn	0.005 %	Ti	0.05 %		

Additional elements can be added. An ICP-MS option is available. Requires a minimum sample weight of 0.2 g. Concentrate samples containing greater than 50% of the target element can require alternative analytical methods if full recovery is required.

FUSION / XRF CONTROL-GRADE PACKAGES

CODE(S)	ELEMENTS / LIMIT(S)	DESCRIPTION
GC XRF76V	Refer to Ore-Grade Analysis section for elements and ranges	Borate fusion / XRF
GC XRF77B	Refer to Ore-Grade Analysis section for elements and ranges	Pyrosulphate fusion / XRF
GC XRF75F	Refer to Ore-Grade Analysis section for elements and ranges	Internal standard / XRF

PROCESS SOLUTION PACKAGES

PROCESS SOLUTION PACKAGE / ICP-AES / NON-CYANIDE BASED (30 ELEMENTS)

GC SOL91T

ELEMENTS AND REPORTING LIMIT(S)

Ag	0.08 ppm	Co	0.3 ppm	Mo	0.6 ppm	Sr	0.002 ppm
Al	0.2 ppm	Cr	0.1 ppm	Na	2 ppm	Ti	0.02 ppm
As	3 ppm	Cu	0.1 ppm	Ni	0.6 ppm	Tl	3 ppm
Ba	0.007 ppm	Fe	0.2 ppm	P	5 ppm	V	0.2 ppm
Be	0.002 ppm	K	1 ppm	Pb	2 ppm	Y	0.02 ppm
Bi	1 ppm	Li	2 ppm	Sb	1 ppm	Zn	0.7 ppm
Ca	0.9 ppm	Mg	0.07 ppm	Se	3 ppm		
Cd	0.09 ppm	Mn	0.04 ppm	Sn	2 ppm		

Additional elements can be added. Requires a minimum sample volume of 5 mL. ICP-MS option may be available locally. Please inquire.

PROCESS SOLUTION PACKAGE / ICP-AES / CYANIDE BASED (30 ELEMENTS)

GC SOL92T

ELEMENTS AND REPORTING LIMIT(S)

Ag	0.08 ppm	Co	0.3 ppm	Mo	0.6 ppm	Sr	0.002 ppm
Al	0.2 ppm	Cr	0.1 ppm	Na	2 ppm	Ti	0.02 ppm
As	3 ppm	Cu	0.1 ppm	Ni	0.6 ppm	Tl	3 ppm
Ba	0.007 ppm	Fe	0.2 ppm	P	5 ppm	V	0.2 ppm
Be	0.002 ppm	K	1 ppm	Pb	2 ppm	Y	0.02 ppm
Bi	1 ppm	Li	2 ppm	Sb	1 ppm	Zn	0.7 ppm
Ca	0.9 ppm	Mg	0.07 ppm	Se	3 ppm		
Cd	0.09 ppm	Mn	0.04 ppm	Sn	2 ppm		

Additional elements can be added. Requires a minimum sample volume of 10 mL. ICP-MS option may be available locally. Please inquire.

INDIVIDUAL METHODS FOR CONTROL-GRADE ANALYSIS

SULPHUR AND CARBON

CODE(S)	ELEMENT	LIMIT(S)	DESCRIPTION	MIN. SAMPLE WT.(g)
GC CSA06V	S	0.01 - 100%	IR combustion	0.2
	C	0.01 - 100%		0.2
GC CSA08V	S ²⁻	0.01 - 100%	Leach/Digest/IR	2.0
GC CSA09V	S (elemental)	0.01 - 100%	Leach/Gravimetry	1.0

Single elements can be determined by numerous decomposition techniques and finishes. Please contact your local lab for options.

VOLUMETRIC AND GRAVIMETRIC METHODS FOR CONCENTRATES

CODE(S)	ELEMENT	LIMIT(S)	DESCRIPTION	MIN. SAMPLE WT.(g)
GC CON13V	Cu	5 - 60%	Titration	2.0
GC CON03V	Cu	5 - 100%	Electroplating	5.0
GC CON07V	Ni	10 - 100%	Electroplating	5.0
GC CON11V	Pb	10 - 70%	Titration	2.0
GC CON12V	Zn	5 - 65%	Titration	2.0
GC CON08V	Fe	10 - 75%	Titration	0.5
GC CLA01V	FeO	>0.2	Titration	0.5

Note: these elements can be analyzed to party or umpire quality standards (GT) and can be reported up to 100%. Refer to the Commercial Trade Analysis section in this guide. Additional elements can be determined on concentrate samples in some SGS laboratories. Please inquire. Trade sample analyses typically require moisture analysis and may require a larger minimum sample weight.

COMMERCIAL TRADE ANALYSIS

SGS is the global leader and innovator in inspection, verification, testing and certification services. Our Minerals Services group, with its global network of laboratories and offices, provides customers with weighing, inspection, sampling and analytical services that are highly respected throughout the industry.

When possible, we follow published, accredited procedures and test methods. As well, SGS can accept your specialty methods and jointly ensure that your analytical results meet your needs and are suitably in control. The SGS Centre of Excellence laboratories that perform these commercial assays conform to the requirements of the ISO/IEC 17025:2005 standard for specific registered tests. SGS recognizes that your reputation and financial position can be at stake during commercial transactions and so we strive to continually improve our services and processes.

SGS' commercial analysis offerings consist of:

- 'Load-port' or 'pre-shipment' assays used by underwriters to quickly confirm product quality and determine approximate value of the shipment. These assays can also be used to calculate partial payment while the parcel or cargo is en-route to the customer. Assay techniques are chosen based on the quality required and turn-around requirements that are demanded during some loading operations.
- Party analyses (also known as settlement or assay exchange analysis) are used to determine the quality of a commodity or product and thus its value and the payment due. The major or payable elements and all minor or penalty parameters are measured and reported. Party assays use commodity-specific methodology and require rigorous quality control steps. SGS employs rugged and reliable procedures, including traditional fire assay, classical gravimetric analysis, electroplating and volumetric titrimetry as well as AAS, ICP-AES and ICP-MS in this type of work.
- Umpire assays are used to resolve a dispute between a buyer and a seller. Samples of the cargo or product are analyzed in triplicate (at minimum) using approved, accredited methods and quality control protocols are set to provide the highest level of accuracy and precision.
- Product verification analysis for validation. SGS has the experience, ability and international approvals to test all types of products against published specifications, such as minimum or maximum limits, weights, quantities or other physical parameters.

SGS Minerals Services works for you to protect your interests and reduce your risk. Please contact us for the services and pricing specific to your commodity, cargo, product shipment and testing needs.

SELECT METHODS

SGS offers a wide variety of select methods to analyze specific elements, species and/or groups of elements. These methods address specific circumstances that arise due to mineralogy, chemistry or commercial requirements. A selection of commonly requested methods are listed below and others are available. Please inquire.

RARE EARTH ELEMENT ANALYSIS

Rare earth element (REE) samples can be analyzed using a variety of techniques depending on the concentration levels in the samples. The following packages are available for trace to percent level concentrations. Please inquire to ensure we meet your requirements.

The following exploration packages contain REEs or can have additional REE elements requested.

RARE EARTH ELEMENT ADD ON TRACE PACKAGES

CODE(S)	ADDITIONAL ELEMENTS*	DESCRIPTION
GE IMS12B / GE IMS14B	Pr, Nd, Sm, Eu, Gd, Dy, Ho, Er, Tm	2-Acid / AR digest / ICP-MS
GE ICM12B / GE ICM14B	Pr, Nd, Sm, Eu, Gd, Dy, Ho, Er, Tm	2-Acid / AR digest / ICP-AES / ICP-MS
GE ICM40B	Pr, Nd, Sm, Eu, Gd, Dy, Ho, Er, Tm	4-Acid digest / ICP-AES / ICP-MS

* REE elements that can be added to existing package

RARE EARTH ELEMENT INCLUSIVE TRACE PACKAGES

CODE(S)	ELEMENTS	DESCRIPTION
GE ICM90A	Refer to pg.39	Sodium peroxide fusion / ICP-AES / ICP-MS
GE IMS95A	Refer to pg.41	Lithium metaborate fusion / ICP-MS

SODIUM PEROXIDE FUSION / ICP-MS REE ORE GRADE PACKAGE (17 ELEMENTS)

GO IMS91B

ELEMENTS AND LIMIT(S)

La 50 ppm	Eu 1 ppm	Er 0.5 ppm	Y 5 ppm
Ce 50 ppm	Gd 5 ppm	Tm 0.1 ppm	U 1 ppm
Pr 10 ppm	Tb 1 ppm	Yb 1 ppm	
Nd 50 ppm	Dy 1 ppm	Lu 0.2 ppm	
Sm 10 ppm	Ho 0.1 ppm	Th 5 ppm	

Note: Other elements are available, please inquire. This technique requires a minimum sample weight of 0.5 g.

BORATE FUSION / XRF REE ORE GRADE PACKAGE

GO XRF76R

ELEMENTS AND LIMIT(S)

La ₂ O ₃ 0.01 - 100%	Nd ₂ O ₃ 0.02 - 100%	Y ₂ O ₃ 0.02 - 100%
Ce ₂ O ₃ 0.02 - 100%	Sm ₂ O ₃ 0.05 - 100%	U ₃ O ₈ 0.01 - 100%
Pr ₂ O ₃ 0.03 - 100%	ThO ₂ 0.01 - 100%	

Note: Other elements are available, please inquire. This technique requires a minimum sample weight of 5.0 g.

SELECT COPPER METHODS

Copper can occur as oxide, sulphide and metallic forms in mineral deposits and metallurgical products so there are a variety of different analytical techniques available.

Note: Refer to the Exploration-Grade Analysis section for descriptions of the 12B, 14B, 40B and 90A digestion techniques. For descriptions of the 13B, 41Q, 42S and 90Q techniques, please see the Ore-Grade Analysis section, and for 13V and 03V refer to the Control-Grade Analysis section.

EXPLORATION-GRADE COPPER METHODS

CODE(S)	LIMIT(S)	DESCRIPTION
GE ICP12B / GE ICP14B	0.5 ppm - 1%	2-Acid digest / Aqua regia – ICP-AES
GE IMS12B / GE IMS14B	0.5 ppm - 1%	2-Acid digest / Aqua regia – ICP-MS
GE ICM12B / GE ICM14B	0.5 ppm - 1%	2-Acid digest / Aqua regia – ICP-AES / ICP-MS
GE ICP40B	0.5 ppm - 1%	4-Acid digest – ICP-AES
GE ICM40B	0.5 ppm - 1%	4-Acid digest – ICP-AES / ICP-MS
GE ICP90A	10 ppm - 5%	Fusion – ICP-AES
GE ICM90A	10 ppm - 1%	Fusion – ICP-AES / ICP-MS
GE IMS90A	2 ppm - 5%	Fusion – ICP-MS

ORE-GRADE COPPER METHODS

CODE(S)	LIMIT(S)	DESCRIPTION
GO ICP13B	0.01 - 30%	Aqua regia digest – ICP-AES
GO ICP41Q	0.01 - 30%	4-Acid digest – ICP-AES
GO AAS42S	0.001 - 50%	4-Acid digest – AAS
GO ICP90Q	0.01 - 30%	Fusion – ICP-AES

CONCENTRATE-GRADE COPPER METHODS

CODE(S)	LIMIT(S)	DESCRIPTION
GC CON13V*	5 - 60%*	Short iodide titration
GC CON03V*	5 - 100%*	Electrogravimetry

* These methods can be done at party or umpire quality (GT). In these cases, the upper end of the reporting range will be 100%.

MINERAL SELECTIVE COPPER METHODS

CODE(S)	LIMIT(S)	DESCRIPTION
GO AAS71D	>0.002%	Cu oxide method, citric acid leach, AAS
GO AAS72B	>0.002%	Cu (non-sulphide method), H ₂ SO ₄ leach, AAS
GO AAS77C	>0.002%	Cu acetic acid soluble, AAS finish
GO CSC67D	>0.002%	CN soluble Cu, AAS finish
GO AAS01D	>0.001%	Metallic Cu, AgNO ₃ digest, AAS
GO SQL01/02/03D	>0.002%	Sequential Cu leach (H ₂ SO ₄ soluble Cu, Cyanide soluble Cu, residual Cu), AAS finish

Note: Slight method and coding variations can occur in different regions.

SELECT NICKEL METHODS

Nickel is used in stainless steels, metal alloys, plating, electric batteries and chemicals. It is found in either sulphide or laterite type ores so analytical methods are needed to ensure complete digestion.

Note: Refer to the Exploration-Grade Analysis section in this guide for descriptions of the 12B, 14B, 40B and 90A digestion techniques. For descriptions of the 13B, 41Q, 42S and 90Q techniques, please see the Ore-Grade Analysis section, and for 06V and 07V refer to the Control-Grade Analysis section.

EXPLORATION-GRADE NICKEL METHODS

CODE(S)	LIMIT(S)	DESCRIPTION
GE ICP12B / GE ICP14B	1 ppm - 1%	2-Acid digest / Aqua regia – ICP-AES
GE IMS12B / GE IMS14B	0.5 ppm - 1%	2-Acid digest / Aqua regia – ICP-MS
GE ICM12B / GE ICM14B	0.5 ppm - 1%	2-Acid digest / Aqua regia – ICP-AES / ICP-MS

GE ICP40B	1 ppm - 1%	4-Acid digest – ICP-AES
GE ICM40B	0.5 ppm - 1%	4-Acid digest – ICP-AES / ICP-MS
GE ICP90A	10 ppm - 10%	Fusion – ICP-AES
GE ICM90A	5 ppm - 1%	Fusion – ICP-AES / ICP-MS
GE IMS90A	5 ppm - 5%	Fusion – ICP-MS

ORE-GRADE NICKEL METHODS

CODE(S)	LIMIT(S)	DESCRIPTION
GO ICP13B	0.001 - 10%	Aqua regia digest – ICP-AES
GO ICP41Q	0.001 -10%	4-Acid digest – ICP-AES
GO AAS42S	0.001 - 5%	4-Acid digest – AAS
GO ICP90Q	0.01 - 30%	Fusion – ICP-AES

CONCENTRATE-GRADE NICKEL METHODS

CODE(S)	LIMIT(S)	DESCRIPTION
GC CON06V	5 - 65%	DMG separation / EDTA titration
GC CON07V	10 - 100%	DMG separation / electroplating

* These methods can be done at party or umpire quality (GT). In these cases, the upper end of the reporting range will be 100%.

MINERAL SELECTIVE NICKEL METHODS

CODE	LIMIT(S)	DESCRIPTION
GO AAS03D	>0.002%	Metallic & sulphide nickel by bromine-methanol leach, AAS finish

Note: Additional selective methods for nickel may be available. Please inquire.

ORES AND COMMODITIES

IRON ORE

SGS has unmatched XRF expertise at many of our laboratories. Iron ore is common in many mineral forms (hematite, magnetite, goethite, limonite or siderite) and analytical methods must be carefully chosen as iron minerals respond differently to various analytical methods. Borate fusion/XRF analysis is an extremely robust technique for major and minor element analysis in complex ores and offers highly precise and accurate results for iron ore samples. This method is not suitable for materials in which sulphide minerals exceed 1%.

BORATE FUSION / XRF IRON ORE PACKAGE (14 ELEMENTS)

GO XRF78S

ELEMENTS AND LIMIT(S)

Al ₂ O ₃	0.01 - 100%	MnO	0.01 - 100%	TiO ₂	0.01 - 100%
CaO	0.01 - 100%	Na ₂ O	0.01 - 100%	V ₂ O ₅	0.01 - 100%
Cr ₂ O ₃	0.01 - 100%	P ₂ O ₅	0.01 - 100%	SO ₃	0.01 - 100%
K ₂ O	0.01 - 100%	Fe ₂ O ₃	0.01 - 100%	LOI	0.01 - 100%
MgO	0.01 - 100%	SiO ₂	0.01 - 100%	SUM	%

Note: Additional minor elements can be added (As, Ba, Cl, Co, Cu, Ni, Pb, Sn, Sr, Ta, Zn and Zr). This method is available using robotic sample preparation as XRF78R in some SGS laboratories. This method is not suitable for samples with sulphide mineral contents > 1%. Please inquire.

VOLUMETRIC METHOD FOR IRON ORE

CODE	ELEMENT	LIMIT(S)	DESCRIPTION	MIN. SAMPLE WT.(g)
GC CON08V	Fe	10 - 75%	Titration	0.5

Note: these elements can be analyzed to party or umpire quality standards (GT) and can be reported up to 100%.

Magnetically susceptible minerals can be extracted from samples. Magnetic materials can be separated from nonmagnetic materials and materials with strong magnetic fields can be separated from materials with low magnetic fields. This property can be used to separate crushed iron ore at various stages of mineral processing.

The Satmagan test provides a measure of magnetic susceptibility, with results expressed as magnetic iron. The Davis Tube test also measures magnetic susceptibility, and can also separate various magnetic mineral phases. This allows for mass and elemental balancing.

SGS offers various magnetic separation techniques.

CODE(S)	TECHNIQUE	DESCRIPTION
GO PHY29V	Satmagan	Measures the total magnetic moment in a saturated magnetic field to determine the percentage of magnetic material present
GO PHY28V	Davis Tube	Separates and gravimetrically determines strongly magnetic particles from weak and non-magnetic particles

URANIUM

SGS complies with all national licensing requirements associated with the safe handling and analysis of naturally occurring radioactive materials samples for transportation, workplace safety and environmental protection. The following analytical packages are specifically designed for uranium exploration and are offered at designated SGS laboratories.

Multi-element packages are listed in the Exploration-Grade Analysis section of this guide for low grade uranium analysis.

URANIUM PACKAGES FOR LOW GRADE MINERALIZATION

CODE(S)	ELEMENTS/ LIMIT(S)	DESCRIPTION
GE IMS12B / GE IMS14B	U (0.05 - 10000 ppm)	2-Acid / aqua regia digest / ICP-MS
GE ICM12B / GE ICM14B	U (0.05 - 10000 ppm)	2-Acid / aqua regia digest / ICP-AES / ICP-MS
GE ICM40B	U (0.05 - 10000 ppm)	4-Acid digest / ICP-AES / ICP-MS
GE ICM90A	U (0.05 - 1000 ppm)	Sodium peroxide fusion / ICP-AES / ICP-MS

GE IMS95A	U (0.05 - 1000 ppm)	Lithium metaborate fusion / ICP-MS
GE MMI-ME	U (1 ppb)	Mobile Metal Ion Technology™ for soils

Multi-element packages are listed in the Ore-Grade Analysis section of this guide. These methods are for medium to highly mineralized samples that include uranium analysis.

URANIUM PACKAGES FOR HIGHER GRADE MINERALIZATION

CODE(S)	ELEMENTS/ LIMIT(S)	DESCRIPTION
GO IMS91B	0.0001 - 1%	Sodium peroxide fusion / ICP-MS
GO XRF75F	0.002 - 3%	Internal standard / XRF
GO XRF76B	0.01 - 100%	Borate fusion with internal standard / XRF

LITHIUM

SGS has the methodology to support exploration and production analysis of lithium. Multi-element packages are listed in the Exploration-Grade Analysis section of this guide for low grade lithium samples.

LITHIUM PACKAGES FOR LOW GRADE MINERALIZATION

CODE(S)	ELEMENTS/ LIMIT(S)	DESCRIPTION
GE ICP12B / GE ICP14B	Li (1 - 10000 ppm)	2-Acid / aqua regia digest / ICP-AES
GE ICM12B / GE ICM14B	Li (1 - 10000 ppm)	2-Acid / aqua regia digest / ICP-AES / ICP-MS
GE ICP40B	Li (1 - 10000 ppm)	4-Acid digest / ICP-AES
GE ICM40B	Li (1 - 10000 ppm)	4-Acid digest / ICP-AES / ICP-MS
GE ICP91A	Li (0.001 - 5%)	Sodium peroxide fusion / ICP-AES
GE ICM90A	Li (0.001 - 5%)	Sodium peroxide fusion / ICP-AES / ICP-MS
GE IMS90A	Li (0.0005 - 1%)	Sodium peroxide fusion / ICP-MS

LITHIUM PACKAGES FOR HIGHER GRADE MINERALIZATION

CODE(S)	ELEMENTS/ LIMIT(S)	DESCRIPTION
GO AAS93B	Li (>0.001%)	Sodium peroxide fusion / AAS
GC ICP91A	Li (>0.001%)	Sodium peroxide fusion / ICP-AES

FLUORSPAR

SGS has the methodology to support testing of fluor spar material. Due to the nature of the test this scheme is only applicable to acid grade or other soluble fluor spar products.

SOLUBLE FLUORSPAR PACKAGE

CODE(S)	ELEMENTS/ LIMIT(S)	DESCRIPTION
GC_CLA37V	Ca (1-50%)	EDTA Titration
	CaCO ₃ (0.1-10%)	EDTA Titration
	CaF ₂ (10-100%)	calculation

Note: For F results under 10%, CaF₂ can be determined by calculation from GC_ISE05V. Samples with Ca content greater than 25% may not be suitable for GC_ISE05V.

GRAPHITIC CARBON

SGS has the methodology to support testing of graphitic carbon.

GRAPHITIC CARBON PACKAGES

CODE(S)	ELEMENTS/ LIMIT(S)	DESCRIPTION	MIN. SAMPLE WT. (g)
GE_CSB05V	C graphitic (0.05%)	Coulometry	0.2
GC_CSA05V	C graphitic (0.05%)	Roast; HCl leach; IR Combustion	0.4
	C graphitic (>30%)	Roast; HCl leach; high temp IR combustion (*SC632)	0.4

GC_CSA06V	Total Carbon (<30%)	IR Combustion	0.2
GC_CSA06VH	Total Carbon (>30%)	High temp IR Combustion (*SC632)	0.2
G_ASH01	**Ash content (0.01-10%)	Gravimetric	20

Note: *SC632 high temperature IR combustion furnace provides greater precision for carbon >30%.

**Ash content is not a suitable measurement of graphite purity for samples containing carbonates or other non-graphitic carbon species and is only recommended for samples >90% graphite.

IMPURITIES FOR GRAPHITIC CARBON (12 ELEMENTS)

GC ICP95A

ELEMENTS AND LIMIT(S)

Al	10 ppm	K	8 ppm	P	20 ppm
Ba	0.3 ppm	Mg	3 ppm	Si	30 ppm
Ca	10 ppm	Mn	0.4 ppm	Ti	0.8 ppm
Fe	20 ppm	Na	5 ppm	Zr	0.3 ppm

Requires a minimum sample weight of 20 g.

Note: Trace impurities are determined by lithium metaborate fusion with ICP-AES analysis on residue obtained by ashing (G_ASH01). Additional impurity elements are available upon request.

Graphitic carbon and impurity analysis is not available at all SGS locations, please inquire.

SGS offers a wide selection of analyses for ores, commodities and concentrates specific to your needs. The following list additional selections, and others are available. Please inquire.

- Manganese ores
- Aluminium ores (bauxite, including extractable SiO₂, Al₂O₃, reactive Si, available Al)
- Tantalum ores
- Industrial minerals (limestone, chromite, borate)
- Fertilizers products (phosphate, sulphur, potash)
- Concentrates and metals
- Mineral sands

ELEMENTS AND PACKAGES

ELEMENT	SYMBOL	ATOMIC NUMBER	MMI	HYDRIDE	TWO ACID	THREE ACID	FOUR ACID	PEROXIDE FUSION	LITHIUM METABORATE FUSION	XRF	FIRE ASSAY - PB	FIRE ASSAY - NIS
Silver	Ag	47										
Aluminium	Al	13				1						
Arsenic	As	33				2						
Gold	Au	79										
Boron	B	5										
Barium	Ba	56				1						
Beryllium	Be	4										
Bismuth	Bi	83										
Calcium	Ca	20										
Cadmium	Cd	48										
Cerium	Ce	58										
Cobalt	Co	27										
Chromium	Cr	24				1						
Cesium	Cs	55										
Copper	Cu	29										
Dysprosium	Dy	66										
Erbium	Er	68										
Europium	Eu	63										
Iron	Fe	26										
Gallium	Ga	31										
Gadolinium	Gd	64										
Germanium	Ge	32										
Hafnium	Hf	72				1						
Mercury	Hg	80										
Holmium	Ho	67										
Indium	In	49										
Iridium	Ir	77										
Potassium	K	19										
Lanthanum	La	57										
Lithium	Li	3										
Lutetium	Lu	71										
Magnesium	Mg	12										
Manganese	Mn	25				1						
Molybdenum	Mo	42				1						
Sodium	Na	11										

1 Limited Solubility or Precipitation by 4-Acid Digestion
 2 Volatile During 4-Acid Digestion

ELEMENT	SYMBOL	ATOMIC NUMBER	MMI	HYDRIDE	TWO ACID	THREE ACID	FOUR ACID	PEROXIDE FUSION	LITHIUM METABORATE FUSION	XRF	FIRE ASSAY - PB	FIRE ASSAY - NIS
Niobium	Nb	41					1					
Neodymium	Nd	60										
Nickel	Ni	28										
Osmium	Os	76										
Phosphorous	P	15										
Lead	Pb	82					1					
Palladium	Pd	46										
Praseodymium	Pr	59										
Platinum	Pt	78										
Rubidium	Rb	37										
Rhenium	Re	75										
Rhodium	Rh	45										
Ruthenium	Ru	44										
Sulphur	S	16										
Antimony	Sb	51					1,2					
Scandium	Sc	21										
Selenium	Se	34					2					
Silicon	Si	14										
Samarium	Sm	62										
Tin	Sn	50					1,2					
Strontium	Sr	38										
Tantalum	Ta	73					1					
Terbium	Tb	65										
Tellurium	Te	52					2					
Thorium	Th	90										
Titanium	Ti	22					1					
Thallium	Tl	81										
Thulium	Tm	69										
Uranium	U	92										
Vanadium	V	23										
Tungsten	W	74					1					
Yttrium	Y	39										
Ytterbium	Yb	70										
Zinc	Zn	30										
Zirconium	Zr	40					1					

1 Limited Solubility or Precipitation by 4-Acid Digestion
 2 Volatile During 4-Acid Digestion

MINERALOGY SERVICES

High Definition Mineralogy is the expert quantitative study of minerals using automated techniques. SGS is the world leader in providing comprehensive automated High Definition Mineralogy to the global minerals industry and other market sectors that need detailed material, product or residue characterizations.

SGS' world-class team of mineralogical professionals provides a significant interpretive value to the High Definition Mineralogy product at every stage of your project. Our expertise, years of experience and comprehensive capabilities allow us to provide crucial input into your strategic decisions, giving you the competitive advantage you need.

While we can support investigations and interpretations of mineralogical data in many industries, we specialize in applications rooted in the exploration and mining industry. High Definition Mineralogy can provide important insights at the acquisition, exploration, prefeasibility, feasibility and operational levels:

SUPPORT FOR MINERAL EXPLORATION AND RESOURCE DELINEATION

Our EXPLOMIN™ products can help map the bulk mineralogy and ore textures with property development. Automated trace mineral searches are also available to identify precious or rare minerals including gold. We can also provide mineralogical, liberation and deportment data and interpretation in support of geometallurgical programs.

SUPPORT FOR METALLURGICAL OPERATIONS AND PLANTS

Our ore characterization and process mineralogy offerings provide detailed snapshots of the factors that influence grindability and metallurgical recovery. Such data is used to support flowsheet development for grassroots start-ups, metallurgical accounting for on-going operations and to benchmark plants during audits and troubleshooting programs.

SUPPORT FOR ENVIRONMENTAL CONSIDERATIONS

SGS provides the identification and deportment (texture) of minerals or phases in natural or industrial environments to:

- Support environmental programs (composition of waste rock, tailings and soils).
- Map deleterious mineral assemblages (As, Pb, Se).
- Establish sources of contaminants using forensic determinations.
- Analyze environments for industrial hygiene purposes (respirable silica and asbestos determinations).

SGS' team of applied and process mineralogists are experienced in the evaluation of ore samples and metallurgical products from a wide variety of commodities. Our Advanced Mineralogy Facilities are equipped with a wide variety of mineralogical equipment and techniques including:

- QEMSCAN®.
- X-ray diffraction (XRD).
- Scanning electron microscopy (SEM).
- Electronic microprobe.
- Optical mineralogy.

Refer to Rocks to Results, Section 5, and www.sgs.com/mining/mineralogy for additional information.

METALLURGY SERVICES

SGS's demonstrated success in metallurgical and process design has provided thousands of companies with effective flowsheets and practical technical solutions to processing problems. From that core of capability, we continue to provide the processing industry with innovative approaches to geometallurgy, process modeling, production forecasting and advanced control systems.

The major activities of SGS's mineral processing, metallurgy and process design experts include:

- Integrated analytical and mineralogical analysis.
- Risk mitigation using geometallurgical solutions.
- Development of environmentally sustainable processes and flowsheets for recovery and purification of pay metals.
- Confirmation of flowsheets via pilot plant testing programs.
- Development of new and innovative technologies for complex ore processing.
- Generation of engineering data for plant design purposes.
- Chemical engineering and process design for production facilities.

- On-site technical evaluations and audits.
- Evaluation and installation of advanced process control using expert systems.
- Evaluation and stabilization of discharge streams and waste products.

SGS provides solid, reliable, reputable, independent solutions for:

- Scoping studies.
- High Definition Mineralogy.
- Flowsheet development.
- Cyanidation technologies.
- Sustainable process development.
- Geometallurgy.
- Pilot plants.
- Bulk sample processing and market sample creation.
- Engineering data generation and modeling.
- Particulate testing.

For more information on the extensive range of bankable metallurgical services offered by SGS, please visit www.sgs.com/metallurgy.

GEOLOGY SERVICES

With over 35 years of experience providing the mining industry with computer-assisted mineral resource estimation services using cutting edge geostatistical techniques; SGS Geostat is known globally as the expert in ore body modeling and reserve evaluation. We bring the disciplines of geology, geostatistics, and mining engineering together to provide you with accurate and timely mineral project evaluation solutions. We also offer a broad range of services to the mining and exploration industries to reduce risk and enhance value. We have the expertise to assist you in the following areas:

- Exploration services including customizable software solutions
- Ore body modeling and resource estimation within our own GENESIS software

- Mine engineering including optimization, design and scheduling
- Mine audits including resources, reserves, mine to plant reconciliation and technical due diligence
- Desktop studies and Technical Reports (NI 43-101, JORC and SAMREC)
- Sample Selection for metallurgical tests to ensure representability
- Training and education on themes discussed above

With over 1000 consulting projects completed worldwide, SGS Geostat is well equipped to minimize your operational and financial risks. You can depend on SGS Geostat's global technical leadership to ensure effective solutions to your exploration and mining challenges.

As part of the larger SGS Minerals group, we can draw upon our massive network of laboratories, metallurgists, process engineers and other professionals to help bring your mineral project to the next level.

GEOLOGICAL MODELING

At SGS Geostat, an orebody modeling project starts with a critical review of geological interpretation according to existing drill hole and surface or underground data and maps. Drill hole and/or sample databases are constructed along with all the quantitative and qualitative information available to build a resource model. Many tools have been developed in our specialized software (GENESIS) including implicit modelling, variable ellipsoids and "fast-mode" modelling. These features provide rapid and flexible modelling solutions providing the Geostat team with an edge.

GEOSTATISTICS AND RESOURCES ESTIMATION

Accurate resource estimation by a Qualified Person (QP) is an essential part of due diligence, and is the corner stone of international reporting standards such as National Instrument 43-101 and JORC. SGS Geostat is an experienced leader in geostatistical techniques and will ensure your resource estimations are completed with the utmost accuracy and integrity. Geostatistics involves the analysis and prediction of the spatial distribution of materials within the earth based on the concept that variability is predictable within a specific ore domain. One of the most important tools utilized to establish these relationships are variograms. The raw data is compiled validated and imported into our proprietary software to calculate variograms; these enable the characterization of the nugget effect and the inherent variability of data in specific directions within the ore domain. Careful construction of the variogram also enables various types of sophisticated algorithms to estimate grades into block models; including kriging (simple, ordinary, lognormal or indicator) and conditional simulations.

CONVERSION FACTORS

There are several advantages to using these advanced methods of interpolation:

- Retention of high-nugget samples during interpolation to minimise metal loss due to smoothing or capping
- Reduce the overall error in resource and reserve estimation
- Quantification of error and even the probability that a given stope or open pit blast of being below the cut-off grade

For more information on the services provided by our SGS Geostats team, visit www.geostat.com

US STANDARD TEST SIEVE SERIES

AMERICAN ASTM	INTERNATIONAL
INCH OR SIEVE	MILLIMETERS OR MICRONS
1.06 inch	26.50mm
1	25.00
7/8	22.40
3/4	19.00
5/8	16.00
0.53	13.20
1/2	12.50
7/16	11.20
3/8	9.50
5/16	8.00
0.265	6.70
1/4	6.30
3 1/2 sieve	5.60
4	4.75
5	4.00
6	3.35
7	2.80
8	2.36
10	2.00
12	1.70
14	1.40
16	1.18
18	1.00
20	850µm
25	710
30	600
35	500
40	425
45	355
50	300
60	250
70	212
80	180
100	150
120	125
140	106
170	90
200	75
230	63
270	53
325	45
400	38
450	32
500	25
635	20

FREQUENTLY REQUESTED EQUIVALENTS

%	G/T (GRAMS / METRIC TONNE)	MG/KG	µG/KG	PPM	PPB
1	10,000	10,000	10,000,000	10,000	10,000,000
0.1	1000	1000	1,000,000	1000	1,000,000
0.01	100	100	100,000	100	100,000
0.001	10	10	10,000	10	10,000
0.0001	1	1	1000	1	1000

CHEMICAL CONVERSION FACTORS

FORMULA	RESULT	FORMULA	RESULT
Al x 1.889	Al ₂ O ₃	Mn x 1.291	MnO
Ba x 1.699	BaSO ₄	MnO x 1.2255	MnO ₂
Ba x 1.116	BaO	Mo x 1.668	MoS ₂
Be x 2.775	BeO	Na x 1.348	Na ₂ O
Ca x 1.399	CaO	Nb x 1.431	Nb ₂ O ₅
Ca x 2.497	CaCO ₃	P x 2.291	P ₂ O ₅
CaO x 1.78479	CaCO ₃	Pb x 1.15474	PbS
Cr x 1.461	Cr ₂ O ₃	Rb x 1.094	Rb ₂ O
Cu x 1.25228	Cu ₂ S	Si x 2.139	SiO ₂
F x 2.055	CaF ₂	Sn x 1.27	SnO ₂
Fe x 1.286	FeO	Sr x 1.185	SrO
Fe x 1.43	Fe ₂ O ₃	Ta x 1.221	Ta ₂ O ₅
Fe x 1.57414	FeS	Th x 1.138	ThO ₂
Fe ₂ O ₃ x 0.69943	Fe	Ti x 1.668	TiO ₂
Fe ₂ O ₃ x 0.89981	FeO	U x 1.179	U ₃ O ₈
Fe ₂ O ₃ x 1.10101	FeS	V x 1.785	V ₂ O ₅
K x 1.205	K ₂ O	W x 1.261	WO ₃
Mg x 1.658	MgO	Y x 1.27	Y ₂ O ₃
Mg x 3.46908	MgCO ₃	Zr x 1.351	ZrO ₂
MgO x 2.09176	MgCO ₃	Zn x 1.49044	ZnS

DRILL CORE SPECIFICATION

	DIAMETER		VOLUME LENGTH	
	(MM)	(INCH)	M ³ X10 ⁻³ / M	INCH ³ / FOOT
AQ	27.0	1.062	0.57	10.6
TT	35.0	1.378	0.96	17.8
BQ	36.4	1.433	1.04	19.3
NQ	47.6	1.875	1.78	33.1
HQ	63.5	2.500	3.17	58.9
BQ3	33.5	1.320	0.88	16.4
NQ3	45.1	1.775	1.60	29.7
HQ3	61.1	2.406	2.93	54.6
PQ3	83.1	3.270	5.43	100.8
PQ	85.0	3.345	5.67	105.5

CONVERSION FACTORS

	TROY OUNCES PER				
	PARTS PER MILLION (ppm)	PARTS PER BILLION (ppb)	METRIC TONNE	SHORT TON	LONG TON
1 Gram / MT	1	1000	0.03215	0.02917	0.0327
1 Troy oz / short ton	34.286	34286	1.1023	1	1.12

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WHEN YOU NEED TO BE SURE





Appendix F – Declarations and Mining Act Awareness Certificates

The following licensed prospectors conducted the assessment work on the property and with their signatures below, attest to the accuracy of the information provided herein:

Jason D. LeBlanc (LIC # 1007516)
239 Hammell Road,
Red Lake, Ontario, Canada

Dennis S. LeBlanc (LIC # 1010471)
71 Dellenor Road,
Red Lake, Ontario, Canada

I, Jason D. LeBlanc, residing at 239 Hammell Road, Red Lake, Ontario, P0V 2M0, state the following with respect to this report:

I wrote this report and produced the accompanying tables and maps based on information collected by the aforementioned prospectors in the course of conducting assessment work in 2018. The information has been presented, and is believed, to be accurate.

Respectfully,

Jason D. LeBlanc, President/CEO
Bounty Gold Corp.